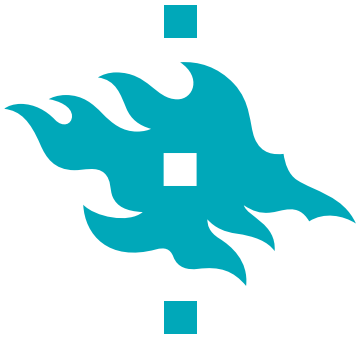

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OTTO RUOKOLAINEN

SOCIOECONOMIC DIFFERENCES IN THE USE OF TOBACCO: FINNISH POPULATION-BASED STUDIES

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SOCIOECONOMIC DIFFERENCES IN THE USE OF TOBACCO: FINNISH POPULATION-BASED STUDIES

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ABSTRACT

Abundant evidence over the decades has proved smoking to be one of the major causes of premature morbidity and mortality. Although the overall health of populations has improved, the smoking-related death toll is still vast and even growing, suggesting urgent need for public health actions. Then again, smoking cessation promotes an array of health gains for the individual, and reducing smoking at the population level results in improved public health.

Smoking is unevenly distributed across population groups; thus creating and sustaining inequalities in health. Differences in smoking by socioeconomic position show that the lower socioeconomic groups smoke more than the higher socioeconomic groups. There is also some evidence that lower socioeconomic groups are less likely to quit smoking. With regard to the use of snus (a Swedish type moist snuff prevalent in Finland), socioeconomic differences are largely unknown. Empirical evidence from Europe, including the Nordic countries, on long term changes in socioeconomic differences in tobacco use and predictors of smoking cessation is scarce. However, these are highly relevant matters for targeting and implementing policies to reduce inequalities in health. Another pivotal factor in the success of policymaking is the attitudes of the population towards tobacco control. In Finland, population-based studies on population acceptance of tobacco control since the early 1990s are lacking.

Following this, the current investigation aimed to improve and elaborate the knowledge of socioeconomic differences in tobacco use and factors contributing to the association in the Finnish population. The specific aims of this study were to shed light on the changes in tobacco use and its determinants between socioeconomic groups, to examine the predictors of smoking cessation and to investigate the societal support for tobacco control in the Finnish population. For addressing these issues, following population-based surveys and health studies from adults and adolescents were utilised: Health Behaviour and Health among the Finnish Adult Population and the Regional Health and Well-being Study in 1978–2016 (N = 104315), School Health Promotion Study in 2008/2009–2017 (N = 384379), Health 2000 and Health 2011 surveys (N = 945), and the National FINRISK Study from 2012 (N = 4905). The main statistical methods in the study included multivariable regression models, such as binary and multinomial regression analyses. Socioeconomic differences in smoking over time were examined with both absolute and relative measures. Throughout the study, education was used as the indicator for socioeconomic position.

The results showed that smoking has declined substantially during the last decades, yet a significant proportion of the adult population still smokes. The lower socioeconomic groups smoke more than the higher socioeconomic groups, and the differences between the groups have increased since the enactment of the Tobacco Act in the late 1970s, indicating widening health inequalities in the future. The price of cigarettes seemed to have a stronger impact on the smoking among the lower socioeconomic groups than the higher socioeconomic groups. Among adolescents, a parallel association between socioeconomic position and smoking was observed. Smoking declined in all socioeconomic groups, yet differences between these groups partially increased. Use of snus increased among boys and socioeconomic differences in boys' snus use were parallel as with smoking

but less pronounced. Strong evidence pertaining to widening socioeconomic differences in adolescent snus use was observed. Adjusting for background variables attenuated the association between socioeconomic position and tobacco use only slightly. Among the general adult population, higher socioeconomic position was longitudinally associated with smoking cessation, more strongly among men than among women, however. Heavy alcohol use, higher depression symptoms, and higher nicotine dependence were associated with a lower likelihood of smoking cessation, the latter being the only statistically significant factor among women. The background variables decreased the effect of socioeconomic position on smoking cessation only modestly. Lastly, high support for strict tobacco control policies was observed among the Finnish population. Smoking status and demographic variables were strongly associated with acceptance of these policies, non-smokers and women being more supportive than smokers and men. One of the few policies that reached the support of only a minority of the population was the societal support for quitters. Lower socioeconomic groups seemed to be less supportive of societal support for quitters than higher socioeconomic groups, although statistically non-significantly. Generally, education was not associated with acceptance of tobacco control.

Finnish health policy aims at reducing inequalities in health, and tobacco control policies can be viewed as one of the means to reach this objective. Finnish tobacco control policy has been successful in many respects, for example in decreasing smoking and preventing adolescent smoking initiation. The results from this study indicate that even though smoking has decreased among all socioeconomic groups, tobacco control policies have not been able to eliminate altogether the socioeconomic differences in tobacco use. Thus, future tobacco control policy actions should concentrate on reducing observed differences in tobacco use by socioeconomic groups, in addition to further reducing the overall prevalence.

TIIVISTELMÄ

Vuosikymmenien aikana kertynyt näyttö osoittaa tupakoinnin olevan yksi merkittävimmistä ennenaikaista sairastavuutta ja kuolleisuutta aiheuttavista tekijöistä. Vaikka väestön terveys on parantunut huomattavasti, on tupakoinnin aiheuttama kuolleisuus edelleen merkittävää ja jopa kasvussa, osoittaen selkeän tarpeen kansanterveyttä parantaville toimenpiteille. Tupakoinnin lopettaminen tuokin huomattavia terveyshyötyjä niin yksilölle kuin kansanterveydelle.

Tupakointi on jakautunut epätasaisesti väestöryhmien kesken aiheuttaen ja ylläpitäen terveyden eriarvoisuutta. Tupakoinnissa havaittavat sosioekonomisen aseman mukaiset erot osoittavat, että matalammassa asemassa olevat tupakoivat korkeammassa olevia yleisemmin. On myös näyttöä, että matalamassa asemassa olevat lopettavat tupakoinnin epätodennäköisemmin kuin korkeammassa asemassa olevat. Nuuskan käytön sosioekonomiset erot ovat suurelta osin tuntemattomia. Tupakkatuotteiden käytön sosioekonomisten erojen pitkäaikaisesta kehityksestä sekä tupakoinnin lopettamista ennustavista tekijöistä on vain vähän aiempaa tietoa Pohjoismaista tai Euroopasta. Nämä ovat kuitenkin keskeisiä tekijöitä, jotta uusia politiikkatoimia voidaan kohdentaa ja toteuttaa terveyden eriarvoisuuden vähentämiseksi. Myös väestön mielipiteet politiikkatoimia kohtaan ja sosiaaliset normit ovat merkittävässä asemassa yhteiskunnallisten muutosten prosessissa. Suomalaisten aikuisten suhtautumista tupakkapolitiikkaan ei ole tutkittu väestötutkimuksilla vuosikymmeniin.

Tämän tutkimuksen tavoitteena oli syventää kuvaa tupakkatuotteiden käytön sosioekonomisista eroista Suomessa ja tekijöistä, jotka tähän vaikuttavat. Erityisesti tutkimuksessa tarkasteltiin sosioekonomisten ryhmien muutoksia tupakkatuotteiden käytössä ja niihin liittyvissä tekijöissä, tupakoinnin lopettamista ennustavia tekijöitä sekä väestön suhtautumista tupakkapolitiikkaan. Näiden teemojen tutkimiseksi käytettiin seuraavia väestö- ja koululaiskyselyitä: Suomalaisen aikuisväestön terveyskäyttäytyminen ja terveys -tutkimusta sekä Aikuisten terveys-, hyvinvointi- ja palvelututkimusta vuosilta 1978–2016 (N = 104315), Kouluterveyskyselyn toiseen asteen opiskelijoiden aineistoja vuosilta 2008/2009–2017 (N = 384379), Terveys 2000 - ja Terveys 2011 -tutkimuksia (N = 945) sekä FINRISKI-tutkimusta vuodelta 2012 (N = 4905). Tutkimuksessa hyödynnettiin kvantitatiivisia analyysejä, kuten erilaisia regressiomalleja huomioiden lukuisat merkittävät taustamuuttujat. Tupakkatuotteiden käytön sosioekonomisten erojen muutosta ajassa tarkasteltiin sekä absoluuttisin että suhteellisin mittarein. Sosioekonomisen aseman mittarina kaikissa osatöissä käytettiin koulutusta.

Tulokset osoittivat, että tupakointi on vähentynyt merkittävästi viimeisten vuosikymmenten aikana, joskin edelleen huomattava osa väestöstä tupakoi. Matalammin koulutetut tupakoivat korkeasti koulutettuja yleisemmin ja koulutusryhmien väliset erot ovat kasvaneet tupakkalain asettamisesta, 1970-luvun lopusta, alkaen viitaten terveyden eriarvoisuuden kasvamiseen tulevaisuudessa. Tupakan hinta vaikutti selkeämmin matalammin koulutettuihin kuin korkeammin koulutettuihin. Aikuisia vastaava yhteys sosioekonomisen aseman ja tupakoinnin välillä havaittiin myös nuorilla. Tupakointi väheni kaikissa nuorten oppilaitostyypin mukaisissa ryhmissä mutta ryhmien väliset suuret erot näyttivät osittain kasvaneen. Poikien nuuskan käyttö yleistyi vuosista

2008/2009 vuoteen 2017 ja nuuskan käytössä havaitut sosioekonomiset erot olivat samansuuntaiset kuin tupakoinnissa mutta maltillisemmat. Poikien nuuskan käytön sosioekonomiset erot kasvoivat sekä absoluuttisin että suhteellisin mittarein mitattuna. Sosioekonomisen aseman ja tupakkatuotteiden käytön yhteys muuttui vain hieman useiden taustatekijöiden vaikutuksesta. Korkeakoulutus ennusti tupakoinnin lopettamista aikuisväestössä, yhteyden ollessa vahvempi miehillä kuin naisilla. Alkoholin suuri kulutus, masennusoireiden suuri määrä sekä korkeampi nikotiiniriippuvuus ennustivat tupakoinnin lopettamisen pienempää todennäköisyyttä miehillä. Naisilla nikotiiniriippuvuuden taso oli ainoa tupakoinnin lopettamista ennustava tekijä. Taustatekijöiden huomioiminen muutti koulutuksen ja tupakoinnin lopettamisen yhteyttä vain vähän. Lopuksi, suomalainen aikuisväestö suhtautui myönteisesti tiukkaan tupakkapolitiikkaan. Tupakoimattomat ja naiset suhtautuivat myönteisemmin tupakointirajoituksiin kuin tupakoijat ja miehet, mutta myös tupakoijat kannattivat joitain rajoitustoimia. Väestöstä vähemmistö kannatti, että yhteiskunnan tulisi tukea tupakoinnin lopettajia. Matalamman koulutuksen omaavat näyttivät suhtautuvan kielteisemmin yhteiskunnan tarjoamaan tukeen tupakoinnin lopettamisessa, mutta ero ei ollut tilastollisesti merkitsevä. Koulutuksen yhteys tupakkapolitiikkaan suhtautumiseen oli pääsääntöisesti heikko.

Suomen terveyspolitiikka tähtää sosioekonomisten terveyserojen kaventamiseen. Tupakoinnin rajoittamis- ja ehkäisytoimet voidaan nähdä yhtenä tekijänä tässä kokonaisuudessa. Suomen tupakkapolitiikkaa voidaan pitää onnistuneena esimerkiksi tupakoinnin vähenemisen ja nuorten tupakoinnin aloittamisen ehkäisyn suhteen. Vaikka koulutusryhmien tupakointi on vähentynyt, eivät tupakkapoliittiset toimet ole onnistuneet poistamaan tupakkatuotteiden käytössä havaittuja sosioekonomisia eroja. Tulevaisuuden politiikkatoimenpiteiden tulisi keskittyä tupakoinnin vähenemisen ohella erityisesti kaventamaan sosioekonomisia eroja tupakkatuotteiden käytössä.

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APPENDIX 2 TOBACCO CONTROL PROPOSITIONS USED IN SUB-STUDY IV 125

LIST OF ORIGINAL PUBLICATIONS

This thesis is based on the following publications:

I Ruokolainen, O., Heloma, A., Jousilahti, P., Lahti, J., Pentala-Nikulainen, O., Rahkonen, O., and Puska, P. Thirty-eight-year trends of educational differences in smoking in Finland. International Journal of Public Health *64*, 853–860, 2019.

II Ruokolainen, O., Ollila, H., Lahti, J., and Rahkonen, O. Intergenerational social mobility, smoking and smokeless tobacco (snus) use among adolescents during 2008–2017. Addictive Behaviors *98*, 106022, 2019.

III Ruokolainen, O., Härkänen, T., Lahti, J., Haukkala, A., Heliövaara, M., and Rahkonen, O. Association between education and smoking cessation in an 11-year follow-up study of a national health survey. Submitted.

IV Ruokolainen, O., Ollila, H., Patja, K., Borodulin, K., Laatikainen, T., and Korhonen, T. Social climate on tobacco control in an advanced tobacco control country: A population-based study in Finland. Nordic Studies on Alcohol and Drugs *35*, 152–164, 2018.

The publications are referred to in the text by their roman numerals.

Figures 4 and 5 and table 7 are adapted from sub-study I. Figures 7 and 8 and tables 8 and 9 are adapted from sub-study II. Table 10 is adapted from sub-study III. Tables 11 and 12 are adapted from sub-study IV.

ABBREVIATIONS

BMI body mass index

CDC Centers for Disease Control and Prevention

CI confidence interval

CPD cigarettes per day

NCI National Cancer Institute

NIPH Norwegian Institute of Public Health

NRT nicotine replacement therapy

OR odds ratio

RII relative index of inequality

SEP socioeconomic position

SII slope index of inequality

TA Tobacco Act

THL Finnish Institute for Health and Welfare

USDHHS U.S. Department of Health and Human Services

WHO World Health Organization

1 INTRODUCTION

Smoking is a major contributor to premature mortality and morbidity (U.S. Department of Health and Human Services (USDHHS) 2014; Doll et al. 2004). The Global Burden of Disease study suggested that smoking is the single most important killer in the world, causing one in ten deaths (Reitsma et al. 2017). It has been shown that smoking kills about half of smokers, but if started at an early age it can kill up to 2 out of 3 of smokers (Peto 1994; Doll et al. 2004; see commentary by Lam 2012). According to the World Health Organization (WHO), "[t]he tobacco epidemic is one of the biggest public health threats the world has ever faced".[1] Indeed, between 1950 and 2015 in high-income Europe, smoking was the cause of at least 18 million deaths (Wensink et al. 2020).[2] These are staggering numbers even though smoking has generally declined in Europe during the last 40 years (Reitsma et al. 2017; Ng et al. 2014). While smoking prevalence has decreased in some parts of the world, morbidity and mortality caused by smoking may still increase in the future: due to population growth, the number of smokers has actually increased (Ng et al. 2014).

Smoking is unevenly distributed among the population so that those with lower socioeconomic position (SEP) smoke more than those with higher SEP (WHO 2019, pp. 34; Hiscock et al. 2012a; Mackenbach et al. 2008). Thus, there are differences also on how the health effects of smoking are distributed across the population groups. Those with lower SEP face more harms of smoking even though the higher smoking rates have been accounted for (Lewer et al. 2017) and lower SEP seems to be a risk factor for greater overall mortality, as well (Stringhini et al. 2017; Härkänen et al. 2020). Smoking elevates mortality risk independent of SEP, and low SEP increases the mortality risk independent of smoking (Härkänen et al. 2020) which posits those smokers with low SEP in a double burden. Although there has been a dramatic change for the better in the overall population health during the recent decades (Wang et al. 2016), socioeconomic differences in smoking have been reported to prevail or increase rather than to decrease (Sandoval et al. 2018; Hu et al. 2017; Lahelma et al. 2016) anticipating widening smoking-related health inequalities in the future.

Compared with the severe health effects of smoking on public health, the upside is that smoking constitutes one of the major preventable causes of premature death and disease. Non-smoking and smoking cessation brings about considerable health benefits for both individuals as well as for public health. For example, never smoking increases the life expectancy of a 30-year-old man by almost seven years (Härkänen et al. 2020) and is a pivotal contributor of years lived without major chronic diseases (Nyberg et al. 2020). Smoking cessation reduces the risk of cardiovascular disease within 5 years of having stopped smoking, although it is only after 10 to 15 years that this risk of a former smoker approximates to that of a never smoker (Duncan et al. 2019). Further, quitting smoking gradually reduces the mortality risk of a past smoker to the level of a never smoker, and the health gains are larger the earlier smoking has ceased (Banks et al. 2015; Mons et al. 2015;

[1] WHO. Tobacco. https://www.who.int/news-room/fact-sheets/detail/tobacco (accessed 4 June 2020)
[2] The study utilised a method that relied on deaths from lung cancer, but smoking plays a substantial role in several other causes of death as well (USDHHS 2014).

Müezzinler et al. 2015; Jha et al, 2013). Smoking cessation is also beneficial on the societal level: smoking brings about substantial costs to society (Makate et al. 2020), while smoking cessation interventions reduce smoking-attributable expenditures and are cost-effective for healthcare (Doll et al. 2004; USDHHS 2020; Bolin 2012; Ekpu and Brown 2015).

In addition to smoking, inequalities in smoking cessation also exist. Smoking cessation may be more probable among those with higher SEP (Hiscock et al. 2012a), and smoking accounts for up to a half of the socioeconomic differences in mortality (Petrovic et al. 2018; Jha et al. 2006). Several underlying explanations have been suggested to elucidate the differences between smoking cessation among socioeconomic groups: smokers in lower socioeconomic groups may be less likely to try to quit smoking (USDHHS 2020, pp. 67; Zhuang et al. 2015) and are usually more addicted to nicotine (Hiscock et al. 2012a; Vangeli et al. 2011). Lower SEP smokers are more prone to quit smoking cessation treatment and the lack of motivation and social support for quitting smoking may also hinder cessation (Hiscock et al. 2012a). Only a few studies have investigated the association between socioeconomic position and smoking cessation among the general adult population. Moreover, these studies show mixed results regarding this association (Vangeli et al. 2011).

In Finland, despite a positive development in decreasing smoking rates since the 1970s, 13% of the adult population still smoked daily in 2019 (Borodulin et al. 2015; Reitsma et al. 2017; Finnish Institute for Health and Welfare (THL) 2020a). In Finland, smoking is strongly related to – or even the predominant cause for – four of the top five causes of premature death (IHME 2019a; IHME 2019b; USDHHS 2014; Durazzo et al. 2014). Annually, over 4000 Finns die from tobacco-related diseases (Vähänen 2015). The socioeconomic differences in smoking are also prevalent in Finland (WHO 2019), yet their changes over time have been understudied. Parallel to adults, smoking is divided between educational groups among adolescents, also (Doku et al. 2010). Examination of changes and predictors of change in adolescent smoking by SEP have been scarce and it warrants further examination in terms of later life inequalities. Smoking in adolescence is a strong predictor of smoking later in life (Dutra and Glantz 2018; Paavola et al. 1996) and the association between SEP and smoking is bidirectional over the life-course: lower SEP predicts smoking later in life and smoking predicts lower SEP later in life (Paavola et al. 2004; Koivusilta et al. 1998).

In addition to smoking, a type of smokeless tobacco, snus, is also used in Finland. Its use is prevalent especially among the male gender, and there has been an increase in its use in the 2000s among adolescents (Leon et al. 2016; Jääskeläinen and Virtanen 2019). Little attention has been directed to the association between SEP and snus use and the changes in this association over time. Including snus use in public health research is pivotal to grasp a more comprehensive picture of changing adolescent tobacco use (Lauterstein et al. 2014) and its possible impact on health inequalities.

In democratic societies, societal attitudes and norms are important qualifiers of policies and policy changes. The norms of a population are transmitted to policies through democratic participation, and policies mutually contribute to social norms that illustrate acceptable behaviours in society (Pacheco 2013). Societal norms and views of population regulate the implementation and enforcement of policies and policy changes. Policy measures could either precede or follow the norms in society (Pacheco 2012). In the former

situation, policies can be seen as educating the masses on what is socially accepted in a given culture (Pacheco 2013). In the latter situation, implemented policies have the possibility to change the attitudes of citizens, as people experience the impacts of the policy themselves (Pacheco 2013). The policy's proximity to a subject, as well as its visibility in society, also matter in the pathways linking policies to attitudes (Pacheco 2013). For example, smoking was widely accepted in the mid–1950s in Finland but its social and cultural position has since changed, and nowadays smoking is generally viewed rather negatively (Hakkarainen 2013). This cultural and social change of smoking from accepted behaviour into a widely unaccepted and strictly regulated behaviour has been titled as denormalisation of smoking (Malone et al. 2012; Sæbø and Scheffels 2017; Hakkarainen 2013). Investigating the societal attitudes towards smoking and tobacco control could help implement future policy changes as well as expound the current acceptance on regulating smoking behaviour. In itself, communicating population attitudes towards tobacco control could also be seen as an intervention in population attitudes.

Reducing inequalities in health is a central aim of the Finnish national health policy, although lack of robust implementation has been criticised (Melkas 2013; Sihto et al. 2009; Sihto and Keskimäki 2000). Finland has a history of strong tobacco control since the late 1970s when the Tobacco Act (TA) was enacted (Patja 2014; Hakkarainen 2013). The tobacco control in Finland has been rather stringent at the European level, although the tobacco industry was successful at delaying policy actions in the late 1980s and early 1990s (Joossens et al. 2020; Hiilamo 2003). The TA has been revised multiple times since it came into force in 1977. A strong measure in the TA towards reducing inequalities in health was set in 2010, and updated in 2016, when the objective of the so-called 'endgame' was introduced. Endgame refers to the situation where smoking has been practically ended (McDaniel et al. 2016). In the Finnish context, the objective will be reached if in year 2030 no more than 5% of the population use tobacco or nicotine products daily (nicotine replacement therapy (NRT) excluded as it is regulated within the Medicines Act). Thus, the TA can be viewed as a part of a more comprehensive health policy aiming to reduce inequalities in health.

Vast differences have been detected in smoking and smoking-related behaviour between socioeconomic groups, but the picture remains incoherent. The purpose of this study is to examine socioeconomic differences in smoking in Finland with national population-based surveys and health studies. The aims are to especially shed light on the changes in tobacco use and its determinants between socioeconomic groups, to examine the predictors of smoking cessation and to investigate the societal support for tobacco control. Examining socioeconomic differences in tobacco use is essential to help target and implement relevant health policies aiming to reduce inequalities in health.

2 CONCEPTUAL FRAMEWORK

2.1 SOCIOECONOMIC POSITION

Social stratification is a concept in sociology which relates to divisions emerging from the positions of people in the hierarchical social structures of society (Lahelma 2010). In medical sociology, the various domains of social stratification that rank the individual/groups in the social hierarchy are referred to as socioeconomic position (SEP) (Lahelma 2010; Krieger et al. 1997). SEP may be viewed as an aggregate concept that signifies diverse components of social and economic well-being as related to both adult and childhood social class position (Krieger et al. 1997). The terms SEP, socioeconomic status, and social class are sometimes used interchangeably, although this has evoked some criticism (Goldman 2001; Glymour et al. 2015; McCartney et al. 2019; Galobardes 2006a). Krieger et al. (1997) define SEP to include both actual resources (for example, academic degree) and status- or prestige-based characteristics (status in relation to access to knowledge). This definition is being applied in this study, as well. The term SEP is employed for uniformity across the text, as well as to follow conventions in the medical sociology and health research literature (Lahelma 2010). In addition, the terms SEP groups and socioeconomic groups are used interchangeably to enliven the text.

The most commonly used individual SEP measures are education, occupation and individual or household income-based measures (Glymour et al. 2015; Lahelma 2010; Galobardes et al. 2007; Laaksonen et al. 2005; Lahelma et al. 2004; Lynch and Kaplan 2000). Sometimes other measures have been utilised as well, such as wealth and housing characteristics, or more macro-level indicators such as area deprivation (McCartney et al. 2019; Galobardes et al. 2006b; Galobardes et al. 2007; Krieger et al. 1997). There are geographical and cultural differences on the use of different measures: in the USA, income measures are common and in the UK occupational social class and area deprivation are more commonly used (Smith et al. 2016). The use of educational attainment is more widespread elsewhere in Europe (Smith et al. 2016). Most of the SEP measures are correlated with each other to different degrees since they measure the aspects of underlying socioeconomic stratification, yet the measures are not interchangeable (Galobardes et al. 2007; Braveman et al. 2005; see also Lahelma et al. 2004). Across life-course, SEP may lead to health inequalities via different pathways as to why it is useful to consider different proxies for SEP (McCartney et al. 2019).

Temporally conceptualising, education is the first individual measure of SEP (Lahelma et al. 2004; Galobardes et al. 2007). Educational level may reflect knowledge, skills, and the structurally determined chances in life and can be regarded as a key socioeconomic indicator in health behaviour research (Lynch and Kaplan 2000; Glymour et al. 2015; Lahelma 2010). Education enables occupational opportunities and higher income. A disadvantage of using education as the measure for SEP relates to defining adolescent SEP (see below). The educational level of the population may also differ over time producing challenges in comparability between and within countries (see Lahelma 2010 of the parallel notion of occupation). In this case, a relative measure of education may be used,

such as the proportion of population with the highest/lowest educational level in a given cohort (Regidor 2004; Galobardes et al. 2006a). The advantages of using education are that it is typically achieved in early adulthood and remains broadly stable thereafter, every individual can be allocated to educational hierarchy irrespective of employment status, and it is equally suitable for women and men (Lahelma 2010).

In addition to education, occupational status links people to social structure and is the conventional measure of social hierarchy (Laaksonen et al. 2005). Occupation-based indicators reflect material conditions related to paid work and work conditions (Galobardes et al. 2007; Lahelma 2004; Laaksonen et al. 2005). Distinctions between occupational classes are based on hierarchy of occupations ranked according to skill, indicating power and status (Krieger et al. 1997; Lahelma et al. 2004). Considering temporal causality, occupational class can be interpreted to follow education but precede income level (Lahelma et al. 2004). The downsides of the measure are that occupational structures change over time, and it is only well suited for those who are or have been employed (Galobardes et al. 2007; Lahelma et al. 2010). In contrast, occupational classification may enable rigorous and detailed classification of employed people (Krieger et al. 1997; Lahelma 2010).

Occupation, as well as education, influences the access to material sources but the key measure of material sources is personal or household income (Krieger 1997; Lynch and Kaplan 2000; Laaksonen et al. 2005). In principle, it is possible to collect accurate income-related measurements (Lahelma 2010), but utilising these in health research is determined on available public registers. Another challenge in using income as a SEP measure is that it may vary considerably in time and it does not necessarily take into account the number of persons dependent on the income (Krieger et al. 1997). Thus, household income may be a more reliable measure of resources than individual income (Lahelma 2010, Laaksonen et al. 2005). Also, gross income and net income may be used to illustrate individual SEP or available resource, respectively (Lahelma 2010).

A term closely accompanying SEP in medical sociology is health inequality. Health inequalities are defined as unjust or unfair disparities in health by SEP to the extent they are avoidable (Lahelma 2010; McCartney et al. 2019). The term health disparity is used especially in the USA (Glymour et al. 2015, p. 56, footnote 1). Further, the concept of inequality in smoking is used to describe a situation where smoking is more common among one group compared with another group (see, for example, Moor et al. 2019; Marmot 2006; Huisman et al. 2005). Thus, in relation to SEP, inequalities in smoking are illustrated by the fact that smoking is generally more common among the lower SEP groups compared with the higher SEP groups (Hiscock et al. 2012a). The use of the term inequalities in smoking can be criticised, as well: tobacco use in itself is not unequal but its consequences that are distributed unevenly across population groups can be viewed as unequal. The use of the term inequality in smoking can be interpreted to refer to the public health aim of reducing health inequalities. In this study, this interpretation is followed and the terms differences in smoking and smoking inequalities are used interchangeably.

Socioeconomic position among adolescents

Different terms have been used to define young people. In the Surgeon General's report on preventing tobacco use among youth and young adults, the following terminology is applied (USDHHS 2012, p. 6): young adolescent (11–14 years of age), adolescent (15–17 years of age), and young adult (18–25 years of age). Following this classification, the current study includes both adolescents and young adults: sub-study II included persons aged 15–21 years while substudies I and IV included persons aged 25 years (and older). For readability, the term adolescent is used throughout this study and the actual age group is determined when necessary (especially in section 3.2).

The key measures of individual SEP are generally not suitable measures when investigating adolescents. Occupation and personal income are inconvenient indicators since basically all adolescents are outside the labour market (Statistics Finland 2020). The highest degree of education may not yet be completed or achieved for adolescents. Hence, several other measures of SEP have been proposed and used to examine smoking and health inequalities. These include, but are not limited to, academic performance or academic orientation, educational entrance (instead of completion), pocket money, parental or family SEP (parental education, parental occupation), parental labour market position, family affluence, subjective social status, and residential deprivation (Moor et al. 2019; Gagné et al. 2018; Sweeting and Hunt 2015; Karvonen and Rahkonen 2011; Doku et al. 2010; Richter et al. 2009; Koivusilta et al. 2006; Hagquist 2000; see also Galobardes et al. 2006a).

In addition to a categorical measure, education can be utilised as a continuous measure, as well (Galobardes et al. 2006a). The measure of continuous study years assumes every year of education contributes similarly to the attained SEP of the person (Galobardes et al. 2006a). The measure is then incapable of capturing the qualitatively different characteristics among horisontally same-level educational attainments (Lynch and Kaplan 2000). In Finland, a prime example of this situation is the two educational tracks at the upper secondary education level after nine years of compulsory education. General upper secondary education can be viewed as a more academically oriented educational track, whereas vocational education institutions are more work-life oriented educational tracks. The registers of higher education graduates support this view (Vipunen 2018).

Relating to terminology, socioeducational level instead of SEP has been used as a concept when examining health-behaviour among adolescents (Øverland et al. 2010). The former can be seen as a narrower concept than the latter, underlining the position to be defined by education. Socioeconomic position does not delimit the dictation of the position of the adolescent to education or education-related aspects but may be viewed to take more broadly into account other societal factors, as well.

Intergenerational social mobility

Intergenerational social mobility refers to a situation where the offspring occupy a different social position than that of their parents. In other words, the social destination of the child is different than his/her social origin (Gugushvili et al. 2019). Intergenerational social mobility is upward when the child reaches a higher SEP than his/her parents, or downward when the child moves down in the social hierarchy compared with the parents.

Immobility or stability refers to a situation where there is no difference between the generations considering the SEP. Another type of social mobility, intragenerational social mobility, refers to a situation where an individual moves downward or upward on the social hierarchy compared with his/her own temporally earlier position.

Social mobility relates closely to the idea of life-course SEP. In this context, the importance of different SEP factors are seen to vary at different stages of life (Robert and House 1996) and SEP at different points in time influences health outcomes differently (Murray et al. 2011; Galobardes et al. 2007; Braveman et al. 2005). Hence, the life-course idea proposes that to understand the interplay between SEP and health, it is important to account for SEP over time and not just at one point of time.

2.2 TOBACCO USE

Tobacco use is an umbrella concept that encompasses use of all types of products that include the tobacco plant. Of the types of tobacco use, smoking cigarettes (generally titled as smoking) is by far the most common way of using tobacco nowadays in the Western societies (Doll 1999). Other types of smoked tobacco products include, for example, cigars, pipes, and waterpipes. In tobacco research, distinctions are feasible to make about different forms of tobacco use, because they have different user behaviour and different health effects (USDHHS 2010; National Cancer Institute (NCI) and Centers for Disease Control and Prevention (CDC) 2014, pp. 5, 315–318; Norwegian Institute of Public Health (NIPH) 2019).

Smokeless tobacco can be chewed, used nasally or placed between the upper lip and the gum (NCI and CDC 2014). The products are many, including, but not limited to, chewing tobacco, snuff and tobacco lozenges (NCI and CDC 2014, Appendix B). The type of smokeless tobacco used differs greatly by country or continent, as does the health effects (Asthana et al. 2019). In the Nordic countries, the Swedish-type moist snuff (snus) is the predominant smokeless tobacco product (NCI and CDC 2014, pp. 310–311, 313–314, B-49–B-50; Leon et al. 2016).

Burning tobacco leaves and inhaling the smoke originates from the Native Americans (Proctor 2004; Doll 1999). Eventually, tobacco leaves were brought to Europe and during the course of the centuries it was developed as the current form of consumer goods known as cigarettes (Proctor 2004; Doll 1999). Proctor (2004) illustrates several crucial factors in society which have been linked to the increase in tobacco smoking, such as development of cigarette rolling machines, distribution of cigarettes to soldiers during World War I, and mass marketing. The policy actions by the governments, such as recognition of tobacco as a reliable source of tax revenue, have also affected the rise of tobacco.

Health consequences of tobacco use

Epidemiological evidence of the health hazards of smoking emerged in the 1920s and a causal link was established in the 1950s (Proctor 2004; Doll 1999).[3] Influential studies conducted in the mid-1950s on morbidity and mortality caused by smoking included the cohort study conducted by Doll and Hill about smoking among British doctors (Doll and Hill 1950; Doll and Hill 1954) and two investigations in the USA of cancer and non-cancer patients by Wynder and Graham (1950) and by Levin and colleagues (1950). The knowledge of the health hazards of smoking were further distributed to larger masses when the report from the Surgeon General was published in 1964 (see USDHHS 2014, p. 3). Smoking among Finnish men was common, over 70%, after World War II, partially due to the fact that tobacco was part of war-time rations in 1939–1945 (Rimpelä 1978; Pranttila 2006).

The uptake of smoking is associated with health harms already among adolescents (USDHHS 2012). The age when smoking starts also matters as regards future health, since early initiation is associated with future daily and heavy smoking (Reidpath et al. 2014; Taioli and Wynder 1991). A multitude of health consequences have been causally linked to smoking and exposure to secondhand smoke, such as lung cancer and several other cancers, chronic obstructive pulmonary disease and other respiratory effects, coronary heart disease, and reproductive effects (USDHHS 2014). Maternal smoking, for example, causes ectopic pregnancy and is associated with preterm delivery (USDHHS 2014). Even though health consequences of smoking are extensive and well-known, new evidence still continues to emerge. For example, in addition to causing dependence, the independent effects of nicotine are still largely unknown (USDHHS 2014; England et al. 2017).

The health effects of snus are less well-known than the health effects of smoking. One reason for this is that snus use is a relatively new phenomenon, and its use is limited to a small geographical area. However, snus includes constituents that are shown to be harmful to health, such as carcinogens and nicotine (NIPH 2019, pp. 17–19, 21, 65). Based on the systematic review by the NIPH, snus use increases the risk of several adverse health outcomes, such as different types of cancers, fatal heart attack, high blood pressure, type II diabetes and metabolic syndrome, and premature birth (NIPH 2019, pp. 15–17, 134–137, 147–148, 153, 161, 174–175). Several other possible negative health outcomes associated with snus use exist, but the evidence is predominantly inconclusive. A limited number of studies and observations in the studies, as well as the rare incidence of some cancers, poses uncertainty in the results (NIPH 2019, pp. 121, 134–136, 155). Also, the evidence considering the health effects of snus relate to men only, as there is lack of studies on the health effects of snus use among women (NIPH 2019). In addition to smoking, snus use is covered in this study, as well (sub-study II).

International and national tobacco control

Tobacco control can be defined as a means to prevent tobacco use and reduce the harm caused by tobacco use. These means include measures to reduce the supply of and demand

[3] Davey Smith et al. (1994) have described the undervalued contribution of German researchers during the Nazi period on the causal association between smoking and health.

for tobacco (WHO 2020). Usually the executors of tobacco control are goverments adopting and implementing different treaties for promoting public health (WHO 2020).

The WHO Framework Convention on Tobacco Control (WHO FCTC) is an international, legally binding instrument developed in response to the globalisation of the tobacco epidemic (WHO 2003; Bertollini et al. 2016). At its core are both price and non-price measures (for example regulation of the product, packaging and labelling of tobacco products, education and public awareness) to reduce the demand for tobacco (WHO 2003). The general obligations demand that each party prevent and reduce both tobacco and nicotine addiction (WHO 2003, Article 5, 2[b]). Finland signed the treaty in 2005, and there are currently 182 parties covering over 90% of the world population.[4] Implementation of this treaty has had a considerable effect on reducing tobacco use among the countries that has signed the treaty (Chung-Hall et al. 2019). Another international tool for tobacco control affecting national legislation is the EU's Tobacco Products Directive (Bertollini et al. 2016). The first Tobacco Products Directive was approved in 2001 and the most recent revision of the directive was enacted in 2014 (Bertollini et al. 2016). An opposing force for tobacco control is, of course, the tobacco industry. The tobacco industry has counteracted tobacco control and hindered prevention of tobacco use with currently well-known tactics (Proctor 2004; USDHHS 2014, pp. 20, 124–125). These include, but are not limited to, funding spurious research, targeting physicians, and refusal to concede the health hazards of smoking (for the Finnish context see Hiilamo 2003).

In Finland, the first TA was enacted in 1976 and the major sets of means of health-oriented tobacco policy included health education, price policy, restrictions, and research and development (Leppo and Vertio 1986). Since the late 1970s, the TA has been revised several times to include, for example, workplace smoking bans in the 1990s, restaurant smoking bans in the 2000s, and point-of-sale ban in 2012 (Patja 2014). Currently, the objective of the TA is to end the use of tobacco and nicotine products by the year 2030 (Finlex 2016a; Finlex 2016b, 1§). The objective of the TA will be reached if no more than 5% of the population uses tobacco or nicotine products daily (NRT excluded since it is regulated under the Medicines Act). This so-called tobacco endgame could be seen as a strong measure to decrease and to eradicate inequalities in health (McDaniel et al. 2016) and as a commitment to prevent both tobacco use and nicotine addiction obligated by the WHO FCTC. This objective is also in line with the aim of the broader Finnish health policy to reduce the inequalities in health (Melkas 2013). All in all, the resrictions on smoking have expanded notably over time and tobacco control in Finland can be viewed as rather stringent (Joossens et al. 2020).

Selling snus is illegal in the EU, but Sweden holds an exemption. In Finland, cross-border import for personal use is permitted for people at least 18 years of age (the same age limit as with other tobacco products). However, illegal trade occurs especially from Sweden and, according to the Finnish Customs, is likely to have increased.[5] According to interview surveys, private import has increased threefold since 2009 (Jääskeläinen and Virtanen 2019, Appendix Table 15).

[4] WHO FCTC 2020. https://www.who.int/fctc/cop/en/ (accessed 30 September 2020)
[5] Finnish Customs 2018. https://tulli.fi/documents/2912305/3727159/Nuuska%2C+tietopaketti/58bc3967-ebda-47fa-b531-18e5d59d1024/Nuuska%2C+tietopaketti.pdf (accessed 30 September 2020)

Operationalising tobacco use

The World Health Organization (WHO) has recommendations on how to operationalise smoking in research (WHO 1998, pp. 80–81). Common ways of classifying smoking is either 'daily smoking' or 'current smoking' (including daily or occasional/not daily smoking). Other common classes based on smoking status are usually 'former smoker' (has stopped smoking a certain time ago, for example within 1–6 months or within 6–12 months) and 'non-smoker' (not smoking currently, including those who have never smoked). Other and more detailed classifications could be made based on the available data, for example 'ever daily smoking' (those who have ever smoked daily for at least one year) (see Helakorpi et al. 2008). Smokeless tobacco use can be classified parallel to smoking but in the Finnish health surveys it is usually measured with one question about the current use of snus (for example 'Do you use snuff?' 'Yes (number of portions) daily', 'Sometimes', 'Not at all') (THL 2017).

A significant concept relating to tobacco use is nicotine dependence. Widely used self-reported measures of nicotine dependence include the Fagerström Test for Nicotine Dependence (FTND) and its shorter version Heaviness of Smoking Index (HSI) (Heatherton et al. 1991; Heatherton et al. 1989). A proposal has been made to change the FTND name to Fagerström Test for Cigarette Dependence to take into account the aspects of smoking, cigarettes as a product, and dependence more broadly than concentrating only on nicotine (Fagerström 2012). Both terms, nicotine dependence and cigarette dependence, are used in the literature (Vangeli et al. 2011). Depedence scales based on FTND have also been proposed for smokeless tobacco use (Ebbert et al. 2006).

Tobacco use can be defined as one type of health behaviour. Health behaviour, or health-related behaviour, refers simply to a behaviour that is related to health. These practices include, but are not limited to, tobacco use, alcohol use, physical activity, dietary patterns, and use of medical care (Petrovic et al. 2018). According to McQueen (1987), health behaviour can be classified into three classes: health enhancing, health-maintaining, and health-damaging behaviour. However, only the umbrella term, health behaviour, is commonly used. Usually the use of this broader term brings no challenges in the interpretation of the public health literature since the outcome measures describe quite unambiguously the type of the health behaviour, for example smoking uptake vs. smoking cessation. To underscore the negative consequences of a behaviour, the term unhealthy behaviour is sometimes used (Petrovic et al. 2018).

Smoking initiation

Smoking initiation refers to situations where a person makes a transition from never smoking to ever smoking or starts regular smoking (Nonnemaker and Farrelly 2011; USDHHS 2012, p. 216). In the former case, smoking either a part or all of a cigarette can be interpreted as smoking initiation (USDHHS 2012, p. 216). Since not all those who try smoking continue to daily smoking, (Birge et al. 2018) initiation rates differ depending on the specified measure of initiation. A similar definition of initiation can be applied to smokeless tobacco use, as well.

Smoking usually begins at an early age: 88% of the first uses of cigarettes occur by the age of 18 and 99% by the age of 26 (USDHHS 2012, p. 134). Of future daily smokers, the

usual age of ever use of cigarettes is 13 to 16 years, and two thirds start smoking before the age of 18 years (USDHHS 2012, p. 134). Both the initiation age of ever use of cigarettes and initiation of daily smoking has increased over time (Cantrell et al. 2018). Also in Finland, the proportion of ever smokers among the underage adolescents has decreased over time (Kinnunen et al. 2019, pp. 17, 93). Smoking initiation may contribute to inequalities in health if the initiation rate is higher in some groups compared with other groups (Green et al. 2016; Bruno et al. 2007).

Smoking cessation

Several different terms for stopping smoking have been used in the literature. These include quitting smoking, stopping smoking, and smoking cessation. These terms are interchangeably used in this study.

Successful abstinence often examines smoking status at 6 to 12 months. For example, a common exclusion criterion in Cochrane reviews about smoking cessation includes a follow-up period less than 6 months (see Stead et al. 2016; Stead et al. 2013). This exclusion criterion is also applied to Finnish Current Care Guidelines (Duodecim 2018). In clinical trials, the definition of successful abstinence is often examined at 1 month, 6 months and 12 months after the treatment (USDHHS 2020, p. 18). In population-based studies, even longer follow-ups have been reported, although rarely (Holm et al. 2017; Ranjat et al. 2020).

Self-reported smoking cessation may yield invalid responses due to recall bias or misreporting (Gorber et al. 2009) Thus, assessments for verifying smoking abstinence have been developed, including biochemical measurements, such as plasma cotinine or plasma urine (Benowitz et al. 2019). Although biochemical verification increases scientific rigor (Benowitz et al. 2019), self-reports of smoking status have been shown to be reliable (Gorber et al. 2009; Vartiainen et al. 2002).

Investigating smoking cessation at the individual-level is possible only with a longitudinal study design. Cross-sectional data have been utilised when examining smoking cessation at the population level over time. In these occasions, quit ratios have been used as the measure for smoking cessation. Quit ratio is defined by the report of the Surgeon General as follows: “The quit ratio represents the percentage of ever smokers who have quit smoking and is defined as the number of former smokers divided by the number of ever smokers. Similar to the prevalence of former smoking, quit ratio is a broad cessation measure encompassing cigarette smokers who quit many decades ago through those who have quit for 1 day at the time of their survey interview.” (USDHHS 2020, p. 61). So, the closer this measure is to 1, the greater the proportion of those who have stopped smoking among the given population.

Tobacco epidemic model and its further applications

Due to its severe health consequences and wide uptake, smoking has been titled as an epidemic (Lopez et al. 1994; Thun et al. 2012; USDHHS 2014). A model describing the development of the epidemic by smoking prevalence and the subsequent smoking-related mortality rates in developed countries was initially proposed by Lopez et al. (1994). In the

model, four stages of the epidemic during the 20th century are described according to the years since smoking began, revealing a 30–40-year lag between the changes in smoking prevalence and subsequent smoking-related mortality.

The first phase of the model describes the beginning of the epidemic where the prevalence is under 20% and corresponds almost fully to smoking among men. Smoking-related diseases and deaths are not yet evident in this phase. The second phase shows a rapid increase in smoking rates: for men, the peak of smoking prevalence of about 50–80% will be reached, while for women the rates lag behind by one or two decades, yet increase. By the end of this phase, smoking is causing one in ten of male deaths but relatively few female deaths. In the third phase, smoking prevalence decreases, yet smoking-related mortality increases rapidly. The last phase of the epidemic sees a slowly continuing decrease in the prevalence, male smoking prevalence being slightly higher than female prevalence. Male deaths due to smoking would peak early in this period and decrease thereafter, while female deaths would increase. However, the proportional smoking-related mortality would be smaller for females than for males since the cumulative exposure would have been smaller for females.

Lopez et al. (1994) consider tobacco control policies and social acceptance of smoking in relation to their model. In the first phase, smoking is socially acceptable and tobacco control policies are underdeveloped while in the third phase tobacco is changing from socially normal to socially unacceptable behaviour. In the final phase, the implementation of smoke-free policies become feasible and policies need also to address smoking cessation support. For Finland, a few other Western European countries, and Australia the model is historical in nature as these countries were already in the third or final phase of the model at the time the model was developed in the early 1990s (Lopez et al. 1994; Mackenbach 2006).

Socioeconomic differences in smoking and their changes were also considered in the model (Lopez et al. 1994; see also Mackenbach 2006, pp. 31–36). Initially, smoking is predominantly a habit of those with higher SEP. In the second stage, smoking prevalence may be similar for socioeconomic groups or slightly higher among more affluent groups. The third phase sees a decrease in smoking prevalence especially among the higher SEP groups. In the final stage, the differences in smoking prevalence between socioeconomic groups persist or may even widen. Dixon and Banwell (2009) have proposed a fifth stage of the model based on data from the USA on the tide of the millennium. According to them, the fifth phase is characterised by the continuing uptake of smoking by successive lower SEP cohorts thus maintaining the inequalities in smoking (Dixon and Banwell 2009). Dixon and Banwell (2009) underline the increasing differences in smoking between SEP groups while the initial model saw this merely as a possible outcome.

The initial model by Lopez et al. (1994) was further expanded by Thun and colleagues (2012) some 20 years later. This updated model showed a continuing decrease in smoking rates among both genders, but the decrease had been slower than was predicted by the initial model. The revised model also showed a decrease in proportionate contribution of smoking to all deaths among men and an increase or plateau among women. Projections for the year 2025 indicated that both smoking prevalence and smoking-related mortality will decrease among both genders "towards lower limits that are not yet defined" (Thun et al. 2012, p. 96). A further extension of the model has projected smoking-attributable mortality rates up to the year 2100 in Europe (Janssen et al. 2020). For Finnish men, the

peak in the smoking-attributable mortality fractions was already reached in the early 1970s, while for women the peak will be reached in 2029. The overall smoking-attributable mortality fractions will stay at a lower level among women (Janssen et al. 2020). These projections support the initial model of Lopez et al. (1994).

2.3 SMOKING AND SOCIOECONOMIC POSITION – WHY USE EDUCATION AS THE INDICATOR?

Social gradient in health and in smoking

Socioeconomic inequalities in health are not randomly distributed among the population; rather, there seems to be a consistent pattern for these differences. A plethora of studies has shown that, irrespective of the outcome, those with lower SEP are worse off than those with higher SEP. This social gradient in health refers to the situation where the morbidity and mortality risk decreases when moving up the hierarchy and gradually increases when moving down the hierarchy (Glymour et al. 2015). There is also not a single threshold for these differences but a gradient of these inequalities across social hierarchy (Glymour et al. 2015). This gradient is also observed in smoking: smoking is negatively correlated with several SEP indicators, and regardless of the measure, those in a less affluent position are more likely to smoke than those with a more affluent position (for example Agaku et al. 2020; Laaksonen et al. 2005). In section 3.1, a more detailed description of the evidence pertaining to this topic is presented.

Figure 1 illustrates the social gradient in smoking by key SEP measures in two countries at two different points in time. A gradient-like association is observed in both occasions, smoking rates gradually increasing when moving from high SEP groups to low SEP groups. Although generally following the hierarchical gradient, there may be relative differences in the smoking prevalence between the consecutive SEP groups. For example, in the EU educational differences are marked especially between the less and the high educated but less pronounced between the middle and the high educated (WHO 2019, p. 34). It is also notable that smoking increases with multiple indicators of disadvantage. It has been estimated that for every indicator of low SEP added, smoking rates increases an extra 5% to 15% (Hiscock et al. 2012b).

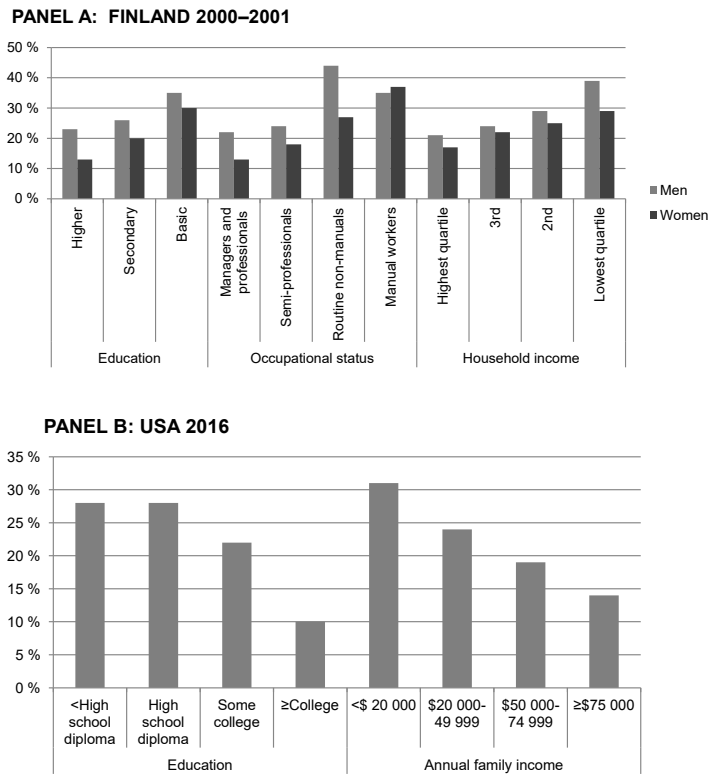

Figure 1 Social gradient in current smoking in Finland in 2000–2001 according to Laaksonen et al. (2005) (Panel A) and in the USA in 2016 according to Agaku et al. (2020) (Panel B). The proportions are crude prevalences (no adjustments).

Interrelationships between indicators of socioeconomic position and smoking

The pathways between different SEP measures and health or health-behaviour may be different from each other. Education is strongly associated with smoking throughout the life-course (Pennanen et al. 2011; Maralani 2013). Studying self-rated health and limiting longstanding illness, Lahelma and colleagues (2004) have proposed the following pathways between the SEP indicators: education exerts its effect on health partially through causally succeeding occupation and income whereas occupational health inequalities may be partly explained by education and mediated through income. The effect of income on health inequalities is to a great degree explained by education and occupation (Lahelma et al. 2004). The key SEP measures are shown to pose independent associations with smoking (Laaksonen et al. 2005; Huisman et al. 2012). Education may have bidirectional association with smoking since lower education increases the likelihood of smoking while smoking deteriorates school performance (Pennanen et al. 2011). Part of the association between education or occupation on smoking may be explained by the other (Laaksonen et al. 2005), indicating some, but not exclusively, shared characteristics. The association between income and smoking attenuates or may be explained by education

and occupation or their joint effect (Laaksonen et al. 2005; Huisman et al. 2012). An attenuated but not entirely explained association may indicate that some unmeasured common factor or factors between SEP measures may influence the association between income and smoking. Education modifies the effect of both occupational status and income on smoking, but occupational status may play a role between them (Laaksonen et al. 2005; Huisman et al. 2012).

Summarising, indicators of SEP have individual associations with smoking, but the effect of education, especially, and to some extent occupation, seems stronger than that of income. Education has an association with smoking independent of occupation and income. Figure 2 depicts a simplification on the possible interrelationships between SEP measures and smoking.

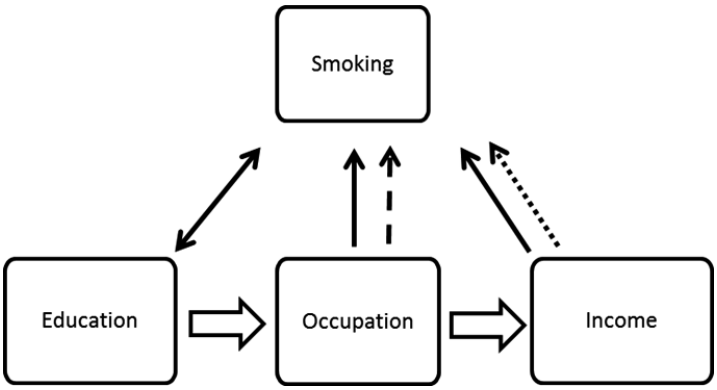

Figure 2 Possible pathways between indicators of socioeconomic position and their association with smoking. Figure modified from Lahelma et al. 2004, based on Pennanen et al. 2011; Laaksonen et al. 2005, and Huisman et al. 2012.
Note: The solid arrows describe the individual effects of SEP measures to smoking and from smoking to education. The dashed arrow describes the modified effect, 'to some degree', of other SEP measures, while the dotted arrow describes a stronger modified effect of the other SEP measures on smoking. The temporal pathway between SEP measures is described by the white arrows.

Reasoning behind using education as the indicator for socioeconomic position

Although measured at the individual level, SEP also takes into account structural relations between different groups in society (Galobardes et al. 2007). Thus, individual SEP indicators are derived from larger social processes that shape the distribution of these indicators across the population (Lynch and Kaplan 2000, p. 22), making the use of these indicators suitable for public health research. For example, an attained educational level of an individual is determined by his/her schooling which, in turn, is constrained by both opportunities for schooling in the given society and family background (Galobardes et al. 2007). Following this interpretation, 'the highly educated' differs from 'the low educated' not just by years of schooling or attained educational level, but also by the underlying structural possibilities that have made it possible for certain individuals to accomplish these educational positions.

Quesnel-Valleé and Jenkins (2010) describe some pathways through which education may lead to overall better health. According to them, a widespread view is that the relationship between education and health is an indirect one, mediated by other factors. These other factors include employability, income, psychosocial resources, and health behaviours. The effect of education on health can be summed up as learned effectiveness, where education cultivates a sense of self-direction. This self-direction then leads to different positive outcomes (Quesnel-Valleé and Jenkins 2010). This kind of life-course examination of smoking and SEP is inconvenient to carry out with either income or occupational level but more feasible with education (Glymour et al. 2015).

Of the SEP measures, education is widely used in epidemiology and public health including tobacco research (Petrovic et al. 2018; Schaap and Kunst 2009; Galobardes et al. 2006a). Several measures have been used to operationalise education. It can be measured as a categorical variable (assessing educational milestones such as completing a degree) or a continuous variable such as schooling years (Galobardes et al. 2006a). Since education may have different meanings for different birth cohorts (Galobardes et al. 2006a), a relative measure of education is useful especially when examining educational differences in smoking over time. For example, among the Finnish population, the educational structure has changed notably since the 1970s: among the population aged 25 and over, the proportion with a high education was 5% in 1970 and 25% in 2018. Concurrently, the proportion with the lowest educational level has decreased from 76% (1970) to 23% (2018) (Statistics Finland 2019).

When taking educational level as the measure for SEP in the context of tobacco use in Finland, the picture seems consistent, yet alarming. Smoking among youth studying at vocational education institutions is more common than smoking among their peers in general upper secondary education (Tseveenjav et al. 2015). The differences are also observable in snus use (Tseveenjav et al. 2015). Among pregnant women, the less-educated smoke more than those with higher education (Härkönen et al. 2018). Among working-aged and older adults, the less educated smoke more than the higher educated (Hu et al. 2017), and there is indication that the higher educated may quit smoking more likely than the less educated (Broms et al. 2004).

Utilising education as the SEP measure in the current study is supported by several additional points. It is obtainable for both adolescents and adults, thus providing better possibilities for comparisons. Among adults, education can be utilised irrespective of the occupational class or working conditions of the person. Individual or household income level as a measure of SEP ignores expenditure: those with a high income may still face economic difficulties (see Rahkonen et al. 2005). Education is also a stronger predictor of smoking than income (Laaksonen et al. 2005; Huisman et al. 2012; Rahkonen et al. 2005). For adolescents, education is a more suitable SEP measure than occupation or income, as mentioned in section 2.1. There is evidence from Finnish and other European studies that individual SEP is a stronger predictor of socioeconomic differences in smoking than parental SEP (Doku et al. 2010; Paavola et al. 2004; Kuntz and Lampert 2013), which further defends the usage of education as a SEP measure in the current investigation.

2.4 ACCEPTANCE OF TOBACCO CONTROL

Public attitudes are quite straightforward to define: they are attitudes of a certain group of people towards a certain measure. A mundane example of population attitudes in democratic societies is opinion polls. The level of acceptance, support or agreement (depending on the wording of the question) refers to a positive stance towards the measure, while the level of disagreement or disapproval refers to a negative stance towards the measure. The interpretation of the level of agreement or disagreement, for example 'high' or 'sufficient', is highly relational. Denormalisation can be defined as the changing of a person's perceptions about a behaviour from more accepted to less accepted (East et al. 2019). Renormalisation is the opposite.

The approval (disapproval) of a population can be simply operationalised as the proportion of respondents with a positive (negative) stance towards the measure as the numerator and the total number of the respondents as the denominator. Eventually, the direction of the attitude (agreement/disagreement) is fully dependent on how the question is presented. For example, one may ask, "Are the recently implemented indoor smoking bans sufficient to protect you from secondhand smoke?", which would yield presumably highly different answers than the question "Are the recently implemented indoor smoking bans insufficient to protect you from secondhand smoke?".

Studies on tobacco control opinions can be broadly divided in two categories based on the outcome measure. In the first category, investigations examine policy actions already implemented. In the analyses, the change in the attitudes of the population towards this policy before and after the implementation of this measure is scrutinised (Lykke et al. 2014; Hayes et al. 2017). The second involves novel tobacco control measures which have not yet been implemented (Brennan et al. 2020; Lund 2016; Hayes et al. 2014).

Marc Willemsen (2018, pp. 89–111) has included societal support as one aspect in a model where he presents the dynamics of tobacco control (Figure 3). Willemsen has named the model the flywheel model of tobacco control. The model includes five different components which interplay with cultural values and social norms in society and define the context in which national tobacco control policy takes place: implementation of tobacco control, smoking rate (or tobacco use rate), public support for tobacco control, political support for tobacco control, and (government's) decision to adopt tobacco control. These five components then interact in a circular manner influencing each other. The name of the model reflects the notion that the process that moves the population towards a smoke-free society is difficult to put in motion, but once in motion, it keeps going for some time until it loses its speed and eventually stops. The wheel keeps turning either through new policy input or because the denormalisation of tobacco use in society continues. As long as the wheel keeps turning, prevalence of smoking will decrease.

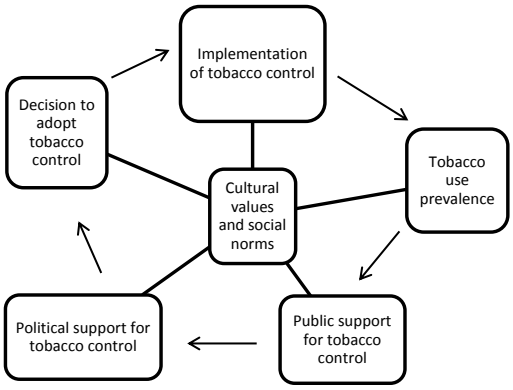

Figure 3 The flywheel model of tobacco control by Willemsen (2018).

According to Willemsen (2018, pp. 92–97), cultural values and social norms play a crucial role in tobacco control. Cultural values determine whether specific policy initiatives are supported or not, while tobacco control evolves around how smoking is perceived in society. At the core of comprehensive tobacco control are the attempts to denormalise smoking instead of merely controlling it. The model predicts that policymakers are more willing to introduce new tobacco control measures when they are supported by the politicians and by the general society, when the population thinks more negatively about smoking, and when the smoking rates are low (yet high enough to draw the attention of the policy-makers). According to the model, public support reflects dominant norms in society. The distribution of the population according to smoking status influences the public support for tobacco control: when the proportion of non-smokers increases, the level of anti-smoking norms and acceptance rate of tobacco control measures increase as well (Willemsen 2018, pp. 89–90).

What the flywheel model does not explicitly account for is the different tobacco products and their possible different cultural and societal positions. For example, social norms and cultural values considering snus use may differ from those of smoking which then, according to the flywheel model, would affect the use rates, public support for tobacco control as well as the implementation of tobacco control policies. The flywheel of tobacco control could turn differently for different products within the same society.

Willemsen (2018, pp. 8–12) presents also a general and broader conceptual framework for understanding the making of tobacco control. The general model contains the same elements as the flywheel model and more, such as the requirements by the EU and WHO. The latter, however, focuses on the population-level factors that decrease smoking rates resulting from the implementation of tobacco control measures. The general model includes – while the flywheel model ignores – the dynamics of the policymaking process itself (Willemsen 2018, p. 91). Since the current investigation does not empirically study the policymaking process, the flywheel model is more applicable in the context of this study. Of the flywheel model components, tobacco use and public support for tobacco control are examined in the current study. Other aspects of the model, for example the implementation of tobacco control and its impact on smoking rates, are covered in chapter 7 (Discussion).

3 REVIEW OF LITERATURE

This chapter summarises the previous literature in the context of this study. The review focuses primarily on population-based studies from Europe but also investigations from other geographical areas are included since the evidence base is different for different subjects covered in this thesis. Smoking, snus use, and smoking cessation were used as the outcome measures in sub-studies I–III, while tobacco control opinions were the outcome measure in sub-study IV. Section 3.1 examines socioeconomic differences in smoking among adults and its changes over time while section 3.2 includes earlier studies on the association between SEP and smoking among adolescents. This section concentrates especially on the association between adolescent smoking and snus use by intergenerational social mobility. In section 3.3, evidence on the association between SEP and smoking cessation is examined, and section 3.4 summarises research on the societal attitudes towards tobacco control. Finally, section 3.5 identifies the gaps in the current literature. Predominantly in the chapter, I will use the term socioeconomic position (SEP) to describe the differences in tobacco use between socioeconomic groups (for example, based on education or occupational class), following the conceptual choice proposed in section 2.1.

3.1 CHANGES IN SOCIOECONOMIC DIFFERENCES IN ADULT SMOKING OVER TIME

Overall association between socioeconomic position and smoking

This section concentrates on the changes in smoking between socioeconomic groups but first, a brief review of evidence considering the association between SEP and smoking is presented. The most common measure of SEP in the studies examining socioeconomic differences in smoking is education (Schaap and Kunst 2009). Other measures, such as occupational class and household wealth, have been utilised as well (Schaap and Kunst 2009). For the smoking measure, current smoking or daily smoking are the two most commonly used measures.

The association between SEP and smoking is rather strong and widely reported in high-income countries. A systematic review by Hiscock et al. (2012a) summarised that smoking rates are generally higher among those with lower SEP in the developed countries. Heavy smoking is also more prevalent in lower socioeconomic groups. Another review examining 70 studies from Europe, the UK, the USA, Australia and New Zealand found very similar associations: higher smoking rates and heavier smoking among those with lower SEP (Schaap and Kunst 2009). Higher smoking uptake and earlier starting age have also been observed among those with lower SEP (Hiscock et al. 2012a; Schaap and Kunst 2009). In addition to several reviews, reports from the WHO and European Commission show consistently higher smoking rates among the lower SEP groups compared with the higher

socioeconomic groups (WHO 2019, pp. 33–34; European Commission 2017, p. 10; European Commission 2015, p. 12; European Commission 2003, pp. 6, 9).

Changes in smoking by socioeconomic groups

Changes in inequalities in smoking by SEP in working-aged adults have been studied in different settings. Not a uniform categorisation of age has been applied across the studies. To illustrate both the differences in prior studies and the current evidence base, studies with at least ten years of follow-up are summarised in Table 1 by their characteristics and findings. The focus is on the European investigations but also other relevant examinations are included. First, these 20 studies are described and after that, few other relevant studies are being outlined.

Two studies have compared SEP differences in smoking in European countries (Hu et al. 2017; Giskes et al. 2005). Both of these studies utilised nationally representative data, and for Finland, partly the same data as in sub-study I was used: Hu et al. (2017) for 30–79 year-olds and Giskes et al. (2005) for 25–79 year-olds (in sub-study I, 25–64 year-olds).

Hu and colleagues (2017) investigated socioeconomic differences in smoking in nine European countries in the context of implemented tobacco control policy actions from 1990 to 2007. Both education (low vs. high) and occupation (manual vs. non-manual) were used as measures for SEP. The studied policies included price policies ("the percentage of per capita GDP required to purchase the 100 cheapest packs of cigarettes") as well as non-price policies (smoking bans or restrictions in the workplaces and public places, bans on advertising and promoting, cessation services, and health warnings). The results revealed that age-standardised smoking was more common among the lower SEP groups than the higher SEP groups. Among men, smoking generally decreased to the same extent within the SEP groups whereas among women, a decrease in smoking among the higher SEP groups was observed. Results were generally similar with education and occupation. Considering the association between policies and smoking, results implied that the lower SEP groups are more sensitive to price changes than the high socioeconomic groups since the association between smoking and price policies was statistically significant only among lower SEP groups. The authors concluded that the implemented price and non-price policy actions have helped to reduce smoking inequalities in smoking. However, an increase in SEP differences in smoking was still observed which, the authors state, is to be explained by other factors. One possible explanation they propose for Finland is the recession in the early 1990s.

Another comparative study examined socioeconomic trends in smoking in nine European countries between 1985 and 2000 (Giskes et al. 2005).[6] This study also observed an inverse association between SEP and smoking. In the combined country analyses, greater declines in daily smoking and tobacco consumption over time were detected among the higher SEP men and women compared with those with lower SEP. Among Finns, there were no differences in the changes in the age-adjusted smoking for different SEP groups among men but a greater decline among women with higher SEP compared with the lower SEP. The authors came to a different conclusion than Hu and

[6] This study is also included in the review by Corsi et al. (2014), see below. The results are described here considering Finland, which are not described in detail by Corsi et al (2014).

colleagues (2017) considering the impact of tobacco control policies: the tobacco control policies were not equally effective in changing the behaviour of different SEP groups since smoking declined the least among the low SEP group.

A Finnish study examined the impact of the 1976 TA on smoking among birth cohorts and socioeconomic groups from 1978 until 2002 (Helakorpi et al. 2008). The same data with a similar age group (25 to 64 year-olds) was utilised in sub-study I. Occupation was used as a proxy for SEP. The investigation found that differences in smoking among socioeconomic groups were clear and smoking among men declined in all SEP groups (farmers being an exception). Among men, the decline corresponding to the TA was the most pronounced in white collar employees. The differences in smoking among SEP groups were larger in later than in earlier birth cohorts. The study concluded that for women, the effect of the 1976 TA was marked in every SEP group and for men, the impact was more pronounced among the higher SEP groups. Another Finnish study examined educational differences in smoking during 1978 and 1992 (Rahkonen et al. 1995). According to the age-adjusted prevalences and their confidence intervals, the differences between the educational groups were reported to had increased. This study also utilised the same data as in sub-study I in the current investigation.

Examination of trends in absolute and relative educational differences in smoking from 2003 to 2012 was carried out in Germany (Hoebel et al. 2018). The results showed that smoking was associated with lower education and trends of declining smoking rates were observed only in the high and medium education groups. Age-adjusted relative differences increased for men (in 2003: RII = 1.74, 95% CI 1.46-2.07; in 2012: RI I= 2.25, 95% CI 1.90-2.67), but a nonstatistically significant change in relative differences for women was observed. For both genders, absolute inequalities were observed but they changed little over time. The authors concluded that striking educational differences in smoking persisted in Germany during 2003 and 2012 and relative differences may have even increased. They also point out that although not capable of causally determining the effect of tobacco control policy on this development, the implemented policy actions have not been capable of diminishing the inequalities in smoking. A similar conclusion was drawn from the study of the impact of a public smoking ban on inequalities in smoking in Geneva, Switzerland (Sandoval et al. 2018). The study found increasing inequalities in smoking prevalence in absolute and relative terms: when adjusted for age, gender, nationality, and the time trend, RII for smoking prevalence was 2.04 (95% CI 1.80–2.30) and SII for smoking prevalence was 0.15 (95% CI 0.13–0.18). The authors concluded that the introduction of a public smoking ban was not sufficient to avoid increases in SEP inequalities in smoking. Summarising, several studies have implied that the impact of tobacco control policies on SEP differences in smoking are ambiguous. This is also supported by a Korean study examining absolute and relative SEP differences in smoking during 1992 and 2016 (Chang et al. 2019).

Ernstsen and colleagues (2012) studied trends in socioeconomic inequality in 1984–2008 regarding smoking, hypertension, high total serum cholesterol, and diabetes. The authors found that daily smoking increased for all SEP groups among women but declined among men. Both absolute (SII) and relative (RII) inequalities in smoking increased, and the development in inequalities over time was similar for both genders. For example, age-standardised relative differences for women were RII = 2.00 (95% CI 1.77–2.24) in 1984–1986 and RII = 2.55 (95% CI 2.28–2.81) in 2006–2008. Absolute differences were for the

corresponding periods SII = 22.54 (95% CI 18.92–26.17) and SII = 30.09 (95% CI 26.74–33.45), respectively. Another Norwegian study conducted age-period-cohort analyses with a nationally representative, randomly sampled interview data from the years 1976 to 2010 (Vedøy 2014). The crude, unadjusted, analyses revealed that those with higher SEP smoked less likely than those with lower SEP. The results indicated that there was a deceleration of educational differences in daily smoking which do not support the widening of health inequalities.

Pärna et al. (2014) examined SEP differences in smoking in Estonia from 1990 to 2010. An inverse relationship between education and smoking was observed for men since mid-1990 (adjusted for age, ethnicity, marital status, employment status) and for women since the early 2000s. SEP differences increased among men and women since the decrease in smoking among the higher SEP groups was greater than among the lower SEP groups.

The association between SEP and smoking in Southern European countries may differ from that observed elsewhere in Europe (Hu et al. 2017; see also Thun et al. 2012). Two Portuguese studies have examined socioeconomic differences in smoking with the same cross-sectional national health interview data with partly different age groups, study years, and SEP measures (Alves et al. 2015; Leite et al. 2019). The results are not as consistent as in most of the other studies regarding association between SEP and smoking, indicating a possibly changing pattern of this association.

Socioeconomic differences in smoking have been examined also in non-European countries with results strongly pointing to increased or sustained differences. These include studies from the USA (Agaku et al. 2020; Maralani 2013; Harper and Lynch 2007), Australia (Ding et al. 2015), and Russia (Shkolnikov et al. 2020). Results from Japan have proposed, in line with Giskes et al. (2005), increased SEP differences in smoking only among women (Hanibuchi et al. 2016). A Canadian study examined current smoking trends with an exceptionally long follow-up, from 1951 to 2011 and found an inverse association between educational attainment and smoking (Corsi et al. 2014). An overall decrease in smoking was observed but as the decrease was greater among the high SEP groups, inequalities in smoking increased. Another Canadian study examining absolute and relative differences in heavy daily smoking (over 10 cigarettes per day) corresponds well with these results (Smith et al. 2009). A review by Corsi and colleagues (2014) identified 19 studies from high-income countries that had various study periods ranging from 1950 to 2008. The results showed that during this time, SEP differences in smoking had generally increased both in absolute and in relative terms.

Table 1 Previous studies of socioeconomic differences in smoking among adults with at least 10 years of follow-up time.

Study	Country	Study design	Age range, years	SEP measure	Estimate for inequalities	Smoking measure	Study period	Sample size, N	Response rate	Findings	Observed change in SEP differences
Agaku et al. 2020	USA	Cross-sectional national survey	18+	Education, annual family income	RII, SII	Current smoking (past 30 days)	2002–2016	Annual sample size 38647 (ranged from 36370 in 2002 to 43561 in 2015)	Average 67% (from 72% in 2002 to 61% in 2014)	• Smoking was more common among the less educated. • Smoking declined in all educational groups but more among the highly educated. • Relative educational diffrences increased while absolute differences remained. • Both relative and absolute income inequalities increased.	Increase/no change
Alves et al. 2015	Portugal	Cross-sectional, national health interview	25–79	Education, income	OR, RII, Concentration Index	Daily smoking	1987–2006	120140	Not reported	• Smoking decreased among men but increased among women. • For men, reversal of educational inequalities from favouring the less educated to favouring the highly educated. In the end of the study period, those men with less income smoked more likely. • The more educated and richer women smoked more likely across the study period.	Reversal of smoking inequalities among men, a slight decrease among women
Chang et al. 2019	Korea	Cross-sectional national survey	19+	Education, occupatio-nal class, income	Prevalence difference, prevalence ratio, SII, RII	Current smoking	1992–2016	524866	"About 70–80%"	• Smoking decreased in all SEP groups. • Absolute and relative educational, occupational and income differences increased among men and women.	Increase
Corsi et al. 2014	Canada	Cross-sectional surveys	20+	Education	Prevalence difference, prevalence ratio	Current smoking	1951–2011	Ranged annually from 1429 to 66288	Response rates were "typically high and varied between 78% [...] and 94%"	• Overall decrease in smoking, the decrease was greater among the high SEP groups. • Relative differences in daily smoking increased among men and women. • A slight reduction in absolute differences among women in "recent years" (data until 2011).	Increase
Ding et al. 2015	Australia	Cross-sectional health survey	16+	Education	Prevalence difference, prevalence ratio	Current smoking	2002–2012	125561	"Around 45%"	• Smoking decreased over time. • Absolute and relative differences increased.	Increase
Ernststen et al. 2012	Norway	Cross-sectional health survey	40–59	Education	SII, RII	Daily smoking	1984–1986, 1995–1997, 2006–2008	60894 (19263, 23658, 17973)	93% to 60%	• Smoking decreased for all educational groups among men and increased among women. • Relative and absolute educational inequalities in smoking widened among both genders.	Increase

Table 1 cont.

Study	Country	Study design	Age range, years	SEP measure	Estimate for inequalities	Smoking measure	Study period	Sample size, N	Response rate	Findings	Observed change in SEP differences
Giskes et al. 2005	Finland, Sweden, Norway, Denmark, UK, Netherlands, Germany, Italy, Spain	Cross-sectional, "national health or multi-purpose surveys"	25–79	Education	RII	Daily smoking, CPD	1985–2000	451386	90% to 56%	• Smoking was more common among the less educated. • No change in inequalities among men, an increase among women.	Increase among women
Hanibuchi et al. 2016	Japan	Cross-sectional national survey	20–64	Education, occupation, income, subjective social class identification	SII, RII	Current smoking	2000–2010	14193	65% to 51%	• Smoking decreased among men and women. • Absolute and relative differences did not change for men. • Relative differences increased (education and occupation) and absolute occupational differences increased among women.	Increase among women
Harper and Lynch 2008	USA	Cross-sectional, representative of US states	25+	Education	Relative Concentration Index	Current smoking	1990–2004	2118562	Not reported[a]	• Smoking declined but relative improvement was better for the high SEP group. • SEP differences in smoking increased.	Increase
Helakorpi et al. 2008	Finland	Cross-sectional, nationally representative postal survey	25–64	Occupation	OR	Ever daily smoking	1978–2002	68071	Averages for the study period: 70% (men), 79% (women)	• Smoking less common among the higher SEP groups. • Smoking declined among men but increased among women. • SEP differences increased according to birth cohorts.	Increase among birth cohorts
Hoebel et al. 2018	Germany	Cross-sectional	25–69	Education	SII, RII	Current smoking	2003–2012	54197	67% to 58%	• Relative SEP differences increased among men but not among women. • No change in absolute SEP differences.	Increase among men (relative differences)

Table 1 cont.

Study	Country	Study design	Age range, years	SEP measure	Estimate for inequalities	Smoking measure	Study period	Sample size, N	Response rate	Findings	Observed change in SEP differences
Hu et al. 2017	Finland, Ireland, the UK, Austria, the Netherlands, France, Italy, Portugal, and Spain	Cross-sectional, nationally representative health surveys	30–79	Education, occupation	OR	Current smoking	1990–2007	563987	Not reported	• Smoking was less prevalent among the high educated for most countries. • Smoking often declined among high SEP groups but the prevalence was generally stable among the low SEP groups. • A widening of inequalities was observed. • The low SEP groups may be affected by the tobacco control policies more than the high SEP groups; lower SEP groups may be more price-sensitive.	Increase
Leite et al. 2019	Portugal	Cross-sectional, national health interview	15+	Occupation, education	OR	Daily smoking	1987–2014	156521 (73593 men, 82928 women)	Not reported	• Inverse association between smoking and education among both genders. • Reduction in smoking prevalence among men and an increase among women. •Increase in educational differences in men, higher educated smoked less frequently in the end of the study period. • A decrease in occupational differences among women.	Increase among men (education)
Maralani 2013	USA	Cross-sectional, representative of population	25–59	Education	Prevalence difference	Current smoking	1966–2010	587174	"[A]nnual response rate of nearly 90% of eligible households sampled"	• The least educated smoke more than the highly educated. • Smoking decreased more among the highly educated across birth cohorts.	Increase
Pärna et al. 2014	Estonia	Cross-sectional	20–64	Education	Relative risk ratio	Daily smoking, occasional smoking	1990–2010	18740	60% to 57% during 2004–2010 (not reported before 2004)	• An inverse association between SEP and smoking for men since 1996 and for women since 2002. • Smoking decreased more among the high educated men than among the less educated men. • Smoking decreased among the high educated women but increased among the less educated women.	Increase
Rahkonen et al. 1995	Finland	Cross-sectional	20–64	Education	Age-adjusted prevalences and their confidence intervals	Daily smoking	1978–1992	Annually between 3400 and 5107	Average 79% (varied between 68% and 86%)	• Smoking more prevalent among the less educated. • Differences between educational groups have increased among men and among women.	Increase

Table 1 cont.

Study	Country	Study design	Age range, years	SEP measure	Estimate for inequalities	Smoking measure	Study period	Sample size, N	Response rate	Findings	Observed change in SEP differences
Sandoval et al. 2018	Switzerland	Cross-sectional, representative of adults from the State of Geneva	35–74	Education	RII, SII	Current smoking, pack years	1995–2014	17544	61% to 51%	• Least educated smoked more likely. • A short-term decrease in smoking prevalence. • Inequalities increased both in relative and in absolute terms.	Increase
Shkolnikov et al. 2020	Russia	Several different survey data, cross-sectional and longitudinal	18–79	Education	OR	Current smoking, daily smoking	1975–2017	From 1109 to 73548	Not reported	• Decline in smoking prevalence among men after 2007 in all educational groups. • Among women, increases in smoking in the lower educational groups from mid-1990s onwards. • Relative differences increased among women since mid-1990s, tendency to increase also among men.	Increase
Smith et al. 2009	Canada	Cross-sectional, population-based surveys	25–64	Education	Prevalence ratio, Relative Concentration Index, Absolute Concetration Index	Daily heavy smoking (>10 CPD)	1974–2005	Varied between surveys from 9280 to 80960	Varied between 85% to "about 95%"	• Lower educational groups were more likely heavy smokers. • Both absolute and relative differences increased.	Increase
Vedøy 2014	Norway	Cross-sectional, nationally representative	24–64	Education	Percentage change in the probability of smoking	Daily smoking	1976–2010	130102 (86200 daily smokers, 43902 never smokers)	"Above 85%" to "around 60%"	• Smoking was more common among the less educated among both genders and across birth cohorts. • Daily smoking decreased faster across cohorts among higher educated compared to the less educated. • Educational differences in smoking increased among early cohorts and levelled off among late cohorts.	Decrease (age), levelling off (cohorts)

[a:] According to an earlier study (Nelson et al. 2002): 60% in 2000 and 84% in 1991.

In addition to the studies presented above, some other recent studies with a shorter follow-up time also deserve attention. A Swedish study examined the change in socioeconomic health inequalities in northern Sweden from 2006 until 2014 (Degerlund Maldi et al. 2019). The twelve examined indicators included such as current smoking, alcohol use, diabetes, and depression. Income and education were used as measures for SEP and SII was used to measure the changes in absolute differences in smoking among SEP groups. The sample sizes were n = 23448 (year 2006), n = 33327 (year 2010), and n = 22637 (year 2014) and 26–84-year-old respondents were included in the analyses. The results indicated that smoking was more common among the lower socioeconomic groups in both genders. For education in 2014, the age-adjusted SII among men was 10.71 (95% CI 8.75–12.68) and among women 12.9 (95% CI 10.95–14.84). Income differences increased while educational inequalities decreased for women. For men, no difference in time was observed. Thus, women experienced larger educational differences compared with men.

Another study investigated changes over time in socioeconomic differences in smoking from the years 1997–2002 (baseline) to 2003–2007 (follow-up) (Lahelma et al. 2016). The study included longitudinal data from Finland (n = 6328), Britain (n = 4350) and Japan (n = 1993) on 36–68-year-olds employed men and women. Socioeconomic position was operationalised as occupational social class and smoking was operationalised as current smoking. The changes in smoking were analysed using aboslute (SII) and relative (RII) measures if inequality. Large socioeconomic differences in smoking were found in Finland and in Britain but not in Japan. Relative differences tended to widen among the Finnish and British men and women but the change over time in absolute differences was statistically non-significant. For example, RII for the Finnish men was 3.08 (95% CI 1.99–4.78) at the baseline and 4.09 (95% CI 2.49–6.72) at the follow-up. Adjusting for sociodemographic (age, marital status) and health-related (BMI, self-rated health) covariates attenuated the association modestly. Similar pattern was observed among the Finnish women but adjustment for covariates attenuated the associations even less. For absolute differences, SII at the baseline for the Finnish men was 0.27 (95% CI 0.15–0.40) and for the Finnish women 0.18 (95% CI 0.15–0.22). The modifying effect of covariates was less pronounced for absolute differences than relative differences. The conclusions of the authors were that SEP differences in smoking persisted in Britain and in Finland and relative differences tended to widen over time. In addition, sociodemographic and health-related factors had only modest effect on the relative and absolute differences in smoking.

Taken together, prior studies show that the lower SEP groups smoke more commonly than the higher SEP groups. While smoking is declining, differences between SEP groups seem to have persisted or increased. The impact of tobacco control policies on SEP differences in smoking is inconclusive, some studies indicating a positive equity impact (policies affect more on the smoking among lower SEP groups) while some studies indicate the opposite.

3.2 SOCIOECONOMIC DIFFERENCES IN SMOKING AND SNUS USE AMONG ADOLESCENTS

In this section, I will first present the earlier findings on the association between SEP and smoking among the adolescents. Prior Finnish studies as well as international comparisons with several years of follow-up are given priority. Then, the association between SEP and snus use is being reviewed based on studies from Northern Europe. After that, I will concentrate on the association between intergenerational social mobility and smoking and snus use. Attention will be given, first, to studies from Europe and, second, studies examining this association over time.

The association between SEP and adolescent smoking

Cross-sectional and longitudinal investigations have been conducted to study the association between adolescent SEP and smoking. Cross-sectional studies from the Nordic countries (Holstein et al. 2020; Tseveenjav et al. 2015; Øverland et al. 2010; Hagquist 2007) as well as international comparisons (Rathmann et al. 2016; Moor et al. 2015; de Looze et al. 2013) have found that adolescent from lower socioeconomic groups smoke more likely than their counterparts. Moor and colleagues (2015) proposed in their comparison of 35 European and North American countries that school and family factors mediate the association between SEP and smoking to a high extent. The results also indicate that an unequal distribution of family- and school-related factors largely explain the association between SEP and adolescent smoking. In another study, Moor et al. (2019) found several SEP indicators to be associated with adolescent smoking. Adolescent's own SEP measures (academic performance, amount of pocket money) were also generally more strongly associated with smoking than parental SEP measures (parental education, family affluence) (Moor et al. 2019). This was true also for Finland: poor academic performance and higher amount of pocket money were associated with current smoking when adjusted for age, gender, and other SEP measures.

Knaappila et al. (2019) utilised a repeated cross-sectional school survey data from Finland to examine smoking among the 8th and 9th graders (14–16-year-olds). The same study was used in sub-study II only with a different target population. The study period was from 2000 to 2015 and the number of observations was N = 761278 (ranging from n = 50404 to n = 109127 per survey year). The authors examined the association between socioeconomic and sociodemographic measures (low parental education, not living with both parents, parental unemployment) and weekly or more frequent smoking. Increasing sociodemographic differences during the study period was found: the overall prevalence of smoking decreased and lifelong nonsmoking increased but smoking among adolescents with the most sociodemographic adversities showed no reduction.

Another Finnish study examined socioeconomic differences in smoking with a cross-sectional postal survey during 1977 and 2007 among 12–18-year-old adolescents (N = 96747) (Doku et al. 2010). Both individual (for 16–18 years old: school performance and school career) and familial SEP measures (parental education and occupation) as well as demographic measures (intact family) were considered. When adjusted for age and study

period, smoking was more common among adolescents in vocational education institutions and those not in school compared with those in general upper secondary education. Poor school performance also associated with the increased probability of smoking. For example, 16- and 18-years-old adolescents in vocational education institutions with a good school performance had four times the odds of smoking compared with those in general upper secondary education with a good school performance (boys: OR = 4.0, 95% CI 3.5–4.5; girls: OR = 3.7, 95% CI 3.4–4.2). Also, a nonintact family structure, low parental occupation, and low parental education increased the probability of adolescent daily smoking. The examination revealed that differences in smoking using individual SEP increased over time and persisted using familial SEP. The authors also concluded that smoking was more strongly associated with the adolescent's own SEP than with familial SEP. However, a longitudinal study following respondents from 16 to 32 years from a Finnish town has implied that parental SEP might have effects on adult smoking other than those mediated by the current SEP of the respondent (Huurre et al. 2003).

Kuipers and colleagues (2015) investigated cross-sectionally the effect of tobacco control policies on 15–16-year-old adolescents smoking in 13 European countries in the years 2003, 2007, and 2011. Smoking was generally more common among the low SEP respondents and declined over time. The authors were unable to demonstrate significant socioeconomic inequalities in the effect of tobacco control policies on adolescent smoking. Another study from the Netherlands investigated socioeconomic differences in daily smoking among 14–19-year-olds (N = 43527) during 1992 and 2011 (Kuipers et al. 2014). The investigation concentrated on the effects of enacted national tobacco control policies in 2003, for example including bans on advertising, sponsoring, and tobacco sales to minors. The researchers observed a decline in smoking prevalence following the enactment of these policies. However, the drop was larger among the high SEP adolescents leading to increased SEP differences. A British longitudinal study also found an association between increasing tobacco control and decreasing smoking rates (Green et al. 2016). Yet again, persistent differences in initiation and escalation to daily smoking between SEP groups were observed (Green et al. 2016). A study from Australia found a decrease in smoking rates among 12–17-year-old adolescents during a period of high tobacco control activity (White et al. 2008). In this study, reductions were consistent across SEP groups, leading the authors to conclude that population-based tobacco control programmes can be effective in reducing smoking among all SEP groups.

Several Finnish longitudinal studies have examined the interplay between SEP and smoking. Dobewall and colleagues (2019) utilised a longitudinal sample of Finnish 7th and 9th graders (N = 10873) to examine the predictors of a late start of the secondary education. In gender and school adjusted models, weekly smoking at the 7th grade was the strongest predictor of a late start of the secondary education. Koivusilta and colleagues (1998) examined adolescent health behaviour and their adult educational outcomes. They found that health behaviour in adolescence predicted the future educational level so that those who reached a low level of education had a health compromising lifestyle in adolescence. Smoking was a strong predictor of attained educational level. The authors suggested that a health compromising lifestyle in adolescence is an important mechanism from which educational health differences stem. Result from yet another Finnish longitudinal investigation support these findings: among young adults, low education was associated with a higher risk for smoking (Kestilä et al. 2006). The strong association of

parental education with daily smoking seemed to be mediated by the adolescent's own education. The conclusion of the study was that determinants of smoking behaviour develop throughout the life-course. Pennanen et al. (2011) examined 2188 Finnish adolescents and observed that poor school performance and smoking have a bidirectional association: smoking contributes to the deterioration of school performance and vice versa.

Pedersen and von Soest (2017) examined the association between parental SEP and future smoking and nicotine dependence among offspring from their "mid-teens until their late 20s" in Norway. They utilised a longitudinal population-based data with a 13-year follow-up. The SEP measures were the line of education (general vs. occupational), educational aspirations, and educational expectations. The study found that future smokers were recruited from families with low educational levels. Smoking was also predicted by poor school grades, school dropout, low educational aspirations, unemployment, and social welfare assistance.

Summarising, studies on the association between SEP and smoking among adolescents show a similar association than among adults: smoking is more common among the lower SEP groups. The differences among SEP groups have more likely widened than narrowed. Generally, adolescents' own characteristics seem to be more strongly associated with smoking than parental SEP measures. However, highly different SEP measures have been used to operationalise adolescent SEP which may play a role in some of the discrepancies in the results between the investigations.

The association between SEP and adolescent snus use

Compared with smoking, studies investigating the association between SEP and snus use are few and mainly from one country, Norway. One explanation is that until recent years, snus was virtually absent from the international markets (Mejia and Ling 2010). Since then some studies from, for example, the United States (Soneji et al. 2015) and Switzerland (Gmel et al. 2018) have emerged. In the light of the current study, the prior research from the Nordic countries are more relevant.

Leon et al. (2016) examined the prevalence and determinants of snus use in Sweden and 17 other European countries among respondents aged 15 and over (N = 18056). The study found that the prevalence of snus use was markedly more common in Sweden (12%) than in other countries (1%). In Sweden, the use of snus was more common among men (21%) than among women (4%). After adjustment for gender, age, level of education, smoking status, and country (Sweden analysed separately), educational differences in snus use were not detected.

Tseveenjav et al. (2015) studied snus use among adolescents in different school types in 2010–2011. Partly the same data were utilised as in sub-study II. They found that male gender, smoking, alcohol use, positive attitudes towards smoking, and a high parental education increased the current use of snus. Parental smoking was not associated with the use of snus. The use of snus use was less strongly associated with the respondents' educational track than smoking. Similar findings have been observed among Norwegian adolescents aged 15 to 16 years (Grøtvedt et al. 2008).

A longitudinal Finnish study of 13–16-year-old boys proposed that those doing better at school are less likely to experiment with snus (OR = 0.77, 95% CI 0.62–0.97) (Haukkala et

al. 2006). A longitudinal Norwegian investigation examined patterns of snus use and smoking from boys aged 16 to 19 years (N = 1440) (Grøtvedt et al. 2013). Socioeconomic position was operationalised as educational plans of the respondent as well as his/her perceived relative family economy. In unadjusted bivariate analysis, little difference between adolescents' educational plans and exclusive snus use (respondent uses snus, does not smoke) was observed but those who perceived their family economy well off used snus more often than others (Grøtvedt et al. 2013). Those with vocational educational plans had higher prevalence of dual use (snus use and smoking) than those with academic plans. In the adjusted model (tobacco use in the baseline, previous smoking, previous snus use, alcohol use, timing of the first sexual experience), well perceived family economy was associated with current snus use (exclusive snus use or dual use) at the follow-up (vs. no tobacco use). Educational plans did not influence the association between tobacco use at the baseline and at the follow-up. Another Norwegian longitudinal study examined tobacco use from adolescence to adulthood among men (N = 1346) (Grøtvedt et al. 2019). The results revealed only minor differences in current snus use between the baseline educational groups, operationalised as plans for future education (ranging from 'not yet decided' to 'university, more than four years'). The prevalence of snus use for these groups ranged from 9% to 13%.

Yet another Norwegian study utilised nationally representative cross-sectional study design to examine the association between SEP and the use of snus and smoking in 2004–2007 among 16–20-years-old (Øverland et al. 2010). No differences in snus use among SEP groups (vocational, academic, other) was detected in adjusted models (age, region) for boys and girls. The results indicated no change in the association between SEP and snus use or smoking over time.

Four studies on snus use among the Finnish male conscripts have been published. Danielsson et al. (2019) investigated the dual use of cigarettes and snus in 2014 (N = 1916). They found no educational differences in daily snus use. A second study found that daily snus use was less common among those with a higher education among recruits from Northern Finland (N = 1151) (Hamari et al. 2013). In the third study, an association between higher SEP (general upper secondary school vs. vocational education institution) and snus use was established (N = 8537) (Tanner et al. 2014). In these three studies, demographic variables such as age were not adjusted for which prevents the interpretation of the results above the studied populations. The data for yet another study on Finnish male conscripts was gathered during 1999 and 2010 (N = 16746) (Mattila et al. 2012). In an age-adjusted model, higher education (general upper secondary school or university) increased the probability of snus use compared with a low education (only comprehensive school) (OR = 1.4, 95% CI 1.1–1.8). No statistical differences between a middle education (vocational education institution) and a low education were detected. This study found a decrease in current smoking (from 42% to 34%) while a slight increase in current snus use (5% to 7%). This finding is accordance with more recent results from the Finnish national reports (Jääskeläinen and Virtanen 2019).

All in all, highly discrepant results on the association between SEP and snus use among adolescents have been proposed. The studies are mainly from Norway but few other studies have also been conducted for example in Finland. However, the Finnish studies rely mainly on data on military conscripts. The findings propose that snus use is more prevalent among boys but the association between SEP and snus use is ambiguous. Studies

on Norwegian and Swedish adults support this interpretation between SEP and snus use although there are indication that snus use could be more prevalent among the lower socioeconomic groups (Tjora et al. 2020; Kvaavik et al. 2016; Engström et al. 2010).

Socioeconomic differences in tobacco use among adolescencts by intergenerational social mobility

The association between intergenerational social mobility and tobacco use, namely smoking, among adolescence has been examined only little in Finland and elsewhere in Europe.[7] Seven studies were identified and they are summarised in Table 2, as well as described below. No prior investigations on the association between snus use and intergenerational social mobility are published.

A Finnish study examined smoking across three generations in 1977–1997 inclduing 54487 adolescents aged 12 to 18 years (Doku et al. 2019). The relation of adolescents' adult education (in 29 years) and parental education as the social mobility measure. The smoking measure for 16–18-year-olds was daily smoking. The results indicated that the higher the upward mobility was, the lower was the likelihood of smoking. Mutually, the lower the downward social mobility was, the higher was the smoking. The most important predictors of smoking were adolescents' low academic achievement and orientation to a low educational level.

Three other Finnish studies on social mobility and smoking were published in late 1990s and early 2000s. Karvonen and colleagues (1999) investigated 8355 adolescents aged 16 and 18 years during 1985 and 1989. The measure for social mobility was constructed based on adolescent's present educational status (at secondary education: vocational education institution or general upper secondary), school attainment (good, average, poor), and labour market position (students, school leavers [including employed, unemployed, those in military service, and those "who stay at home"]) in relation to parental occupational class. The results showed, first, that smoking was more frequent among those in a lower achieved social position. Second, age and gender-adjusted models showed that downward mobility from the upper white collar and the lower white collar origins increased the risk for smoking relative to the stable peers (relative risk 4.0, 95% CI 3.1–5.2 and 2.0, 95% CI 1.7–2.4, respectively). Upward mobility, then again, decreased the risk for smoking.

[7] Social mobility has been studied among adults: see for example Gugushvili et al. (2020) for 25–64-year-olds and Singhammer and Mittelmark (2010) for 24–31-year-olds. Since adult social mobility is not the focus of his research, these studies are excluded from this literature review. However, the overall picture between social mobility and smoking is similar among adults than among adolescence.

Table 2 Previous studies of the association between intergenerational social mobility and smoking among adolescents.

Study	Country	Study design	Age range, years	Intergenerational social mobility measure	Smoking measure	Study period	Sample size, N	Response rate	Findings
Doku et al. 2019	Finland	Cross-sectional postal survey, nationally representative, with register linkages	12–18	Adolescents' adult education level (high, middle, low) (at 29 years) in relation to their parents' education level (high, middle, low), separately for father and mother.	Differs by age, daily smoking for 16–18 year olds	1979–1997	54487	79% (72% for boys, 86% for girls)	• The higher the upward mobility, the lower the likelihood of smoking • The lower the downward mobility, the higher the likelihood of smoking. • Adolescents' orientation to low educational level and low academic achievement were the most important predictors of smoking.
Glendinning et al. 1994	Scotland	Longitudinal, postal and school survey	16–22	Adolescent's current occupational class in relation to father's occupational class	Regular smoking (at least one cigarette per week)	1987–1989	1171	Not reported	• Smoking was more common among the downwardly mobile and stable low groups. • Smoking was less common among the upwardly mobile and stable high groups.
Karvonen et al. 1999	Finland	Cross-sectional postal survey, nationally representative	16–18	Adolescent's present educational status, school attainment, and labour market position in relation to parental occupational class	Daily smoking	1985–1989	8355	79 %	• Smoking was more prevalent among the downwardly mobile groups compared with the stable adolescents from the same class of origin. • Smoking was less frequent among the upwardly mobile groups compared with the stable adolecsents from the same class of origin.
Kuntz and Lampert 2013	Germany	Nationally representative	12–17	Difference between parental education and adolescent's own education (both low/high)	Current smoking	2003–2006 (pooled)	5053	67 %	• Stable low and downwardly mobile boys had an increased risk for smoking (vs. stable high boys) • Stable low girls had a increased risk for smoking (vs.stable high girls) • Upward mobility was associated with lower smoking rates (vs. stable low groups).
Novak et al. 2012	Sweden	Longitudinal	16–30 (from baseline to follow-up)	Movement between parental occupational class (at 16 years) and adolescent's own occupational class (at 30 years)	Current smoking	1981–1995	1041 (546 men, 495 women)	97 %	• Smoking was the most common among downwardly mobile men and women. • Smoking was the least frequent among stable high men and upwardly mobile women. • Downward mobility predicted greater probability of smoking among both genders. • Upward mobility predicted lower probability of smoking among women.

Table 2 cont.

Study	Country	Study design	Age range, years	Intergenerational social mobility measure	Smoking measure	Study period	Sample size, N	Response rate	Findings
Paavola et al. 2004	Finland	Longitudinal	13–28 (from baseline to follow-up)	Difference between adolescent's own education and parental education (both low/middle/high)	Weekly smoking	1978–1993	903	71 %	• Smoking was the most frequent among the downwardly mobile group. • Smoking the least common among the upwardly mobile group. • Social mobility did not associate with smoking.
Pulkki et al. 2003	Finland	Longitudinal	12–21 (baseline) to 21–30 (follow-up)	Difference between adolescent's own education and parental education (both low/high)	CPD	1983–1992	1219 (531 men, 688 women)	62 %	• The number of CPD was not associated with intergenerational mobility. • The downwardly mobile group showed a tendency to smoke more than others.

Paavola et al. (2004) followed 13-years old adolescence until 28 years of age. Intergenerational social mobility was assessed as the difference score between parental and subject's own years of education and the outcome variable was weekly smoking. The study found that smoking was the most frequent among those whose own SEP was the lowest and had decreased two steps from their parental SEP (downwardly mobile group). In contrast, those who had a high individual SEP and whose SEP had increased two steps from their parental SEP had the smallest smoking prevalence (upwardly mobile group). However, the interaction term in a logistic regression model (weekly smoking as the dependent variable; own education at 28 years, parental education, and parental smoking as the independent variables) between own education and parental education was statistically non-significant, indicating that social mobility did not associate with smoking.

A longitudinal examination including 531 Finnish men and 688 Finnish women studied the association between cynical hostility and cardiovascular risk factors from the years of 12–21 (baseline) until 21–30 years (follow-up) (Pulkki et al. 2003). The movement between parental education and the adolescent's own education (both low/high) was used as the measure for mobility, and smoking was operationalised as CPD. Comparison of age-adjusted means among intergenerational social mobility groups revealed that the downwardly mobile group smoked a larger number of CPD than others (for men: mean 11.54, standard error 2.82; for women: mean 3.68, standard error 1.23). The stable low men (mean 4.17, standard error 1.26) and the stable high women (1.68 mean, standard error 0.39) smoked on average the lowest number of CPD. However, the number of CPD did not show differences in one-way analyses of variance among the intergenerational mobility groups, indicating no statistically significant differences between the groups.

A Swedish 14-year prospective longitudinal study investigated the determinants of social mobility from 16 years until 30 years (Novak et al. 2012). The study included 546 men and 495 women whose occupation, health status, health-related behaviour (including current smoking), psychosocial environment at home and school, material recourses, and ethnicity were examined. Smoking was the most common among the downwardly mobile groups (men 33%, women 50%) and the least frequent among the stable high men (12%) and the upward mobile women (25%). Upward mobility predicted a lower probability of current smoking in univariate and multivariable regression analyses (all the studied background variables in the model, plus 'have children at 30 years of age'), but statistically significantly only among women. For women, univariate estimates were OR = 0.40, 95% CI 0.23–0.70, and multivariable estimates OR = 0.25, 95% CI 0.08–0.82. Downward mobility predicted a higher probability of current smoking statistically significantly among both genders in the univariate and multivariable models. Adjusting for background variables attenuated the association especially among men (univariate model OR = 4.75, 95% CI 1.61–13.96; multivariable model OR = 2.34, 95% CI 1.06–5.19).

A Scottish study from the mid-1990s investigated intergenerational occupational mobility among 16 to 22 year-old adolescents and young adults (Glendinning et al. 1994). The study found clear differences in smoking in relation to adolescent's current socioeconomic status (for example, full-time education, employed, unemployed). Smoking was also more prevalent among the stable low and the downwardly mobile groups and less common among the stable high and the upwardly mobile groups.

An investigation from Germany examined intergenerational social mobility and smoking with a nationally representative cross-sectional sample of adolescence aged 12 to

17 years (Kuntz and Lampert 2013). The results indicated that those with a stable low position had a greater likelihood of smoking compared with adolescents with a stable high position, adjusting for age, region of residence, immigration background, and parental and close friends' smoking behaviour. The estimates were over twofold (boys: OR = 2.67, 95% CI 1.76–4.04; girls: OR = 2.22, 95% CI 1.54–3.20). Downward mobility associated with a greater likelihood of smoking but statistically significantly only among boys. Upward mobility was not associated with smoking when the stable high group was the reference group. When the stable low adolescents acted as the reference group, upward mobility was associated with lower smoking rates among both genders (boys: OR = 0.32, 95% CI 0.20–0.53; girls: OR = 0.52, 95% CI 0.37–0.73). The results also indicated that adolescent smoking was more strongly associated with their personal educational level than that of their parents.

All in all, prior studies show clear differences in smoking among intergenerational social mobility groups: the downwardly mobile and the stable low adolescents are at a greater risk for smoking compared with their peers. There is some variation between results considering, for example, the crude and the adjusted associations, but generally the results point in the same direction. Findings are also supported by studies from Australia (Gall et al. 2010) and Sweden (Ericsson et al. 2019) examining cardiovascular disease risk behaviours and mortality, respectively. There are no prior studies on the association between intergenerational social mobility and snus use. Thus, the change in this association over time has either not been examined.

3.3 SOCIOECONOMIC DIFFERENCES IN SMOKING CESSATION

Studies on factors predicting smoking cessation are vast, including systematic reviews, longitudinal studies with a prospective cohort design and interventions on healthcare sites, for example. In addition, cross-sectional studies are usually conducted when examining smoking cessation rates between countries. Less examined is the association between SEP and smoking cessation especially with longitudinal adult general population-based samples. These nine identified studies are summarised in Table 3. All these studies utilised a self-reported (not biochemically verified) smoking status.

Table 3 Previous adult general population studies on the association between socioeconomic position and smoking cessation.

Study	Country	Study design	Age range, years	SEP measure	Classification of smoking cessation	Sample size at the baseline [analytic sample size], N	Response rate at the follow-up	Study period	Finding	Assocation between SEP[a] and smoking cessation
Chandola et al. 2004	Britain	Annual longitudinal population representative survey	16+	Education, occoupational social class, income	Cessation of smoking (reported smoking in previous survey and not smoking in two subsequent surveys)	3058 [2614]	Not reported	1991–2000	• Higher occpuational social class predicted smoking cessation. • No association between education/ income and smoking cessation.	0/+
Graham and Der 1999	UK	Longitudinal, representative of British women	16–65	School-leaving age, educational qualifications, occupation, housing tenure	Cessation of daily smoking (at least one cigarette per day)	934	100 %	1991–1993	• Higher school-leaving age predicted smoking cessation.	+
Holm et al. 2017	Seven centres in Northern Europe	Longitudinal	Population born during 1945–1973	Education	Cessation of current smoking ("Are you a smoker (answer in the affirmative even if you smoke just a single cigarette, cigar or pipe per week)?" Yes/No)	4636	67 %	Baseline 1999–2001, follow-up 2010–2012	• Highest education (but not the middle education) predicted smoking cessation compared with the least educated.	+
Margolis 2013	USA	Longitudinal, representative of the US population	50–75	Education	Cessation of smoking (reported smoking in previous survey and not smoking in subsequent survey)	[16606]	92 %	1992–2010	• Smoking cessation more probable among the high SEP groups.	+
Martin et al. 2019	UK	Longitudinal, only women	Baseline mean age 58.3 years	Education, deprivation	Cessation of current smoking ("Are you a smoker now?" Yes/No)	95346	56 %	2001–2005	• No association between education and smoking cessation.	0
Rafful et al. 2013	USA	Longitudinal, nationally representative	18+	Education, individual income	Cessation of "current tobacco use" (neither current use nor cessation defined more explicitly)	[1868]	87% (overall Wave 2 response rate, not spesific to this study)	2001–2002 (baseline) to 2004–2005 (follow-up)	• The only predictors of successful quitting were lower educational level and older age at first nicotine use.	-
Weinberger et al. 2014	USA	Longitudinal, nationally representative	18+	Education	Smoked either less than 100 cigarettes between waves 1 and 2 or had not smoked in the 12 months prior to the wave 2	33309	86 %	2001–2005	• Those with college education were more likely to report smoking cessation.	+

Table 3 cont.

Study	Country	Study design	Age range, years	SEP measure	Classification of smoking cessation	Sample size at the baseline [analytic sample size], N	Response rate at the follow-up	Study period	Finding	Assocation between SEP[a] and smoking cessation
Yi et al. 2017	USA	Comparing two longitudinal cohorts, nationally representative	18+	Education	Transition from current smoking (have smoked at least 100 lifetime cigarettes and smokes currently either 'every day' or on 'some days') to former smoking (have smoked at least 100 lifetime cigarettes and do not smoke currently)	[15410] in 2002–2003, [18393] in 2010–2011	Not reported	2002–2003, 2010–2011	• The least educated had smaller or greater likelihood of smoking cessation compared with the highest educated, depending on the cohort.	+/-
Zhuang et al. 2015	USA	Comparing two longitudinal cohorts, nationally representative	25+	Education	Smoked 12 months prior to the survey and had quit smoking for at least 3 months at the time of the survey	On average 5669 (NHIS survey) and 34156 (TUS-CPS survey).	Not reported. [b]	1991–2010, 1992–2011	• Cessation rates were higher among the high educated over two decades. • Quit attempt rates were higher among the high educated compared with the low educated.	+

[a]: (+) : An observed positive association between SEP and smoking cessation; (-) : An observed negative association between SEP and smoking cessation; (0): An observed statistically non-significant association between SEP and smoking cessation.

[b]: "[T]he annual response rate of NHIS is approximately 70 percent of the eligible households in the sample" (CDC National Health Interview Survey. https://www.cdc.gov/nchs/nhis/about_nhis.htm (accessed 17 June 2020)).

A review investigated predictors of smoking cessation in adult general population samples up to the end of the year 2010 (Vangeli et al. 2011).[8] The study reviewed 17 articles (corresponding to eight unique studies) including several demographic variables (for example gender, age, SEP measures, employment, marital status), and smoking-related variables (for example CPD, cigarette dependence, past quit attempts, intentions to quit). The review included studies from Europe, North America, and Asia. Education was used as the SEP measure in 14 of the included articles. Three of these articles found no significant association between education and smoking cessation, ten articles (from the same unique study) found a positive association at $p<0.05$ (the higher the education, the more likely was quitting smoking) and one study found a negative association at $p<0.01$ (the higher the education, the less likely was quitting smoking). The authors also conducted a pooled analysis of five studies (including one pooled study of 10 articles) and no association was found between the level of education and smoking cessation (OR = 0.95, 95% CI 0.75–1.21). Income was used as the SEP measure in 13 of the studies (12 studies included both education and income) and only non-statistical or negative associations between income and SEP on smoking cessation were observed. Social class was also used as a proxy for SEP in two studies and no statistically significant associations with smoking cessation were observed. The results from the review indicated that SEP did not consistently predict smoking cessation. The only factor that consistently predicted smoking cessation was cigarette dependence; an association which has been observed in other studies too (Ranjit et al. 2020; Broms et al. 2004; Hyland et al. 2004). As the review by Vangeli and colleagues (2011) show, objective measures of nicotine dependence, such as plasma cotinine level, have seldom been utilised in general adult population studies.

Another review including longitudinal twin data from Australia found that higher educational attainment increased the probability of smoking cessation (Koning et al. 2015). An additional year of education was observed to reduce the duration of smoking with 9 months. Also a twin study from Finland including 3069 respondents found that high education was positively associated with smoking cessation (men: OR = 2.32, 95% CI 1.31–4.10; women: OR = 3.98, 95% CI 1.85–8.51) (Broms et al. 2004).

A population-based study on adult general population was carried out in seven cities in Northern Europe, namely Bergen (Norway), Umeå, Uppsala and Gothenburg (Sweden), Reykjavik (Iceland), Aarhus (Denmark), and Tartu (Estonia) (Holm et al. 2017). The study included 4636 middle-aged current smokers and the follow-up period was from 1999–2001 to 2010–2012. The study found that smoking cessation rate ratio was higher among the highest educated as well as among those with high school or similar education compared with those with less education than high school. Results from the adjusted Cox regression models revealed that smoking cessation was predicted by the highest education (vs. the lowest education) but not middle education (for men hazard ratio = 1.75, 95% CI 1.23–2.50; for women hazard ratio = 1.46, 95% CI 1.07–2.00). Smoking cessation was also predicted by fewer smoking years and by higher age, the latter for women only.

Several studies from the USA have investigated smoking cessation with population-based samples. A nationally representative study comparing two longitudinal cohorts showed inconsistent results regarding the likelihood of cessation between SEP groups (Yi et al. 2017). Another study, partly utilising the same nationally representative data as Yi et al. (2017) over two decades, implied that the less educated lagged behind the high educated

[8] Individual studies included in the review by Vangeli et al. (2011) are excluded from this review and Table 3.

in terms of cessation rate (Zhuang et al. 2015). In this study, the low SEP group also made fewer quit attempts compared with the high SEP group. The authors stated that about of half the difference in cessation rates between SEP groups can be attributed to the higher quit attempt rates among the high SEP group and half to the difference in the success rate. Weinberger et al. (2014) analysed general adult population data and found that respondents with a college education were more likely to report smoking cessation (OR = 1.27, 95% CI 1.05–1.53). Another study utilising a sample of older adults (aged 50 to 75 years) from the USA concluded that number of educational years was positively associated with smoking cessation in a 18-year follow-up (Margolis 2013). The number of CPD was negatively and consistently associated with smoking cessation across bivariate and multivariable models.

Contradictory findings considering SEP and smoking cessation have also been observed. An investigation, representative of US adults followed approximately for three years, found that lower education was associated with a higher likelihood of smoking cessation (Rafful et al. 2013). The unadjusted ORs for moking cessation for those with education below high school were OR = 6.59 (95% CI 1.25–34.69). No adjusted analyses were conducted to examine the effect of other factors on this association. A British study investigated a large sample of women with a four-year follow-up (Martin et al. 2019). The analytical sample consisted of 53650 current smokers whose baseline mean age was 58.3 years. The study found a smaller likelihood of smoking cessation among those with no educational qualifications and among those with secondary education (compared with the high educated) in the unadjusted model. However, when adjusted for age, age of smoking initiation, CPD, time between surveys and self-rated health, the associations attenuated and was no longer statistically significant (for example for those with no qualification: OR = 0.95, 95% CI 0.88–1.03). Another study including a representative sample of British women concluded that low number of CPD was the strongest predictor of smoking cessation at 1- and 2-year follow-ups, but also higher school-leaving age predicted cessation (Graham and Der 1999). The association between occupational class and smoking cessation suggested in the same direction (non-manual vs. manual/no occupation OR = 1.74, 95% CI (1.00–3.05). Yet another investigation among British adults found that the strongest predictor of continued smoking was the degree of depedence (Chandola et al. 1994). In this study with a 10-year follow-up, a lower occupational social class was associated with a lower likelihood of smoking cessation while education and income did not associate statistically significantly with smoking cessation (Chandola et al. 1994).

Also several non-general adult population longitudinal studies have found a positive association between SEP and smoking cessation. These investigations have been conducted in stop smoking services or other service locations (a review: Smith et al. 2020a; Mayne et al, 2019; Clare et al. 2014; Bauld et al. 2012; Hiscock et al. 2012a; Fernández et al. 2006), or in geographical areas or communities (Gorini et al. 2018; Hyland et al. 2004; Lindström et al. 2002; Hymowitz et al. 1997). One Swedish study examining 65-years-olds in two counties indicated that there was no association between education and smoking cessation (university vs. not university: OR = 1.5, 95% CI 0.6-3.7) (Ordell and Ekbäck 2019).

In addition to longitudinal studies, the association between SEP and smoking cessation have been examined in comparative cross-sectional settings. A study comparing 11 European countries showed large socioeconomic differences in smoking cessation from the

1990s and during the 2000s, and an increase in these differences (Bosdriesz et al. 2015a). Similar finding has been observed in a Swiss study investigating the impact of a public smoking ban on quit rates (Sandoval et al. 2018). Additionally, tobacco control has been associated with more smoking cessation among the higher educated in 27 European countries (Bosdriesz et al. 2016). However in the Netherlands, the implemented tobacco control policies were not associated with increased educational inequalities in smoking cessation during 1988 and 2011, resulting the authors to interpret that the less and high SEP groups seemed to have benefit about equally of these policies (Bosdriesz et al. 2015b). In two investigations including eight and six European countries, smokers with low SEP reported less quitting activity than those with higher SEP (Hummel et al. 2018; Hedman et al. 2018). A study from the USA implied that smokers with higher SEP quit smoking both more likely and earlier in their life compared with smokers from lower socioeconomic groups (Maralani 2013).

In sum, SEP seems to be associated with smoking cessation so that the higher SEP smokers quit smoking more likely than the lower SEP smokers. Several longitudinal studies from stop smoking services as well as cross-sectional studies on quit ratios support this view. However, the evidence from the few conducted general adult population studies is highly mixed. In addition, there is lack of general adult population studies focusing on the association between SEP and smoking cessation. Even though subjective measures of nicotine dependence are shown to be strong predictors of smoking cessation, general adult population studies have seldom been able to utilise objective measures of nicotine dependence.

3.4 SOCIETAL ACCEPTANCE OF TOBACCO CONTROL

There is plethora of studies on population attitudes on tobacco control policies, including several reviews, individual investigations and European-level reports (for the last-mentioned, see for example European Commission 2017). This section concentrates especially on prior literature on adult opinions on tobacco control from the Nordic countries, which are also summarised in Table 4. In addition, recent studies from other high-income countries are included as well. First, results from reviews are described, following the description of the Nordic studies. Finally, studies with a more holistic operationalisation of tobacco control opinion measures are characterised.

A systematic review investigated acceptance of government interventions to change health-related behaviours, including smoking, alcohol use, diet and physical activity (Diepeveen et al. 2013). Of 200 included studies between 1980 and 2011, 110 were about tobacco control and majority of them from the USA (n = 52). Other included countries and areas were Australia or New Zealand, Canada, and Europe.Only one study examining adult opinions was included from the Nordic countries, from Finland (Heloma and Jaakkola 2003).[9] The review found that smoking-related interventions as well as less intrusive interventions gathered more support than other interventions. Interventions that were already implemented and those targeting children and young people attracted the most

[9] This study is included also in Table 4 to give a comprehensive picture on studies on societal acceptance of tobacco control among adults in the Nordic countries.

support. Support was the highest among those not engaging in the targeted behaviour, hence, non-smokers felt more positive about restrictions than smokers. Especially women and older respondents but also higher income groups were more likely to endorse more restrictive measures of tobacco control.

Reviews investigating attitudes towards smoke-free outdoor regulations (Thomson et al. 2016; Thomson et al. 2009) and attitudes towards smoke-free public vehicles (Thomson and Wilson 2009) have included studies from North America, the UK, and Australasia. The reviews found strong support for studied policies and the support seemed to increase over time. Especially measures protecting children from secondhand smoke (SHS) were largely supported, also among smokers (Thomson et al. 2016; Thomson and Wilson 2009). Some demographics associated with acceptance of tobacco control, such as female gender, but the association between SEP and tobacco control opinions was more ambiguous (Thomson et al. 2016).

In Finland, attitudes towards tobacco control have rarely been studied among the general adult population, namely in the mid-1970s and in the early 1990s. A study of Finnish Medical Journal (1975)[10] found high acceptance rates of tobacco control measures relating to smoking restrictions before the first TA was enacted in the 1970s. An almost 90% acceptance rate of banning tobacco advertising and banning smoking in public indoor places was reported. Acceptance of smoking restrictions was higher among non-smokers and the lower SEP groups. No results from formal statistical tests to investigate the differences between population groups were reported. Paavola et al. (1991) described population attitudes to smoking from 1988 to 1990. The results implied that smoking restrictions would be widely accepted among employed population: 96% of women and 84% of men agreed that smoking should be restricted or banned at workplaces.

Heloma and Jaakkola (2003) utilised a pre-post design associated with the enactment of the national smoke-free workplace law when examining the attitudes of employees. The study found that both smokers' and non-smokers' attitudes shifted to favouring a total ban on smoking at workplaces after the law was implemented. However, a larger proportion of non-smokers (52%) than smokers (15%) supported a total ban on smoking at the end of the study period. A fourth Finnish study investigated the attitudes of male conscripts to (then) recent smoking restrictions and second-hand smoke (Nieminen et al. 2010). The study showed an acceptance rate of 44% of the restrictions on smoking in restaurants, bars and in all indoor public places. A smaller proportion of respondents reported protesting if they would be exposed to SHS originating from their neighbors (16%). Current smokers and the less educated opposed recent legislative actions more likely when adjusted for age and parental smoking. They were also the least disturbed by the balcony smoking.

[10] Other articles of the same study, conducted during 1974–1976, have been published as well (for example Rimpelä 1976). In this review, the results from Finnish Medical Journal (1975) study are described as it included several measures of tobacco control opinions.

Table 4 Previous studies on tobacco control opinions in the Nordic countries.

Study	Country	Study design	Age range, years	Opinion measure	Study period	Sample size, N	Response rate	Finding
Finnish Medical Journal 1975[a]	Finland	Cross-sectional, representative of the Finnish population, interviews (unclear whether telephone or face-to-face)	15+	Eight tobacco control measures related to the first TA (then under preparation), e.g. "Tobacco advertising should be prohibited", "The sale of tobacco to persons under the age of 15 should be prohibited".	1974–1975	998 (in 1974), 1035 (in 1975)	Not reported	• High support for smoking restrictions. • Support for smoking restrictions higher among non-smokers, women, and lower SEP groups.[b]
Heloma and Jaakkola 2003	Finland	Cross-sectional, employees of 8 workplaces from Helsinki metropolitan area	15+	Preferred workplace smoking policy	1994–1998: before the change, 1 year and 3 years after the change	880, 940 and 659	70%, 75%, 75%	• Attitudes shifted towards favouring a total ban on smoking at work. • This was observed both among smokers and non-smokers.
Lund 2016	Norway	Cross-sectional, internet panel	20+	Opposition to 16 new/potential tobacco control strategies	2014	5250	Not reported	• Non-smokers supported regulations more than smokers. • Daily smokers opposed 13 of the 16 proposed strategies. • Smokers accepted regulations on SHS, but defended their right to smoke in outdoor areas.
Lykke et al. 2014	Denmark	Cross-sectional, random sample	25–79	"Do you think that smoking in the following arenas should be permitted, restricted or banned?" (11 sites, e.g. schools, workplaces, hospitals, cafes)	2007 and 2010	35821 in 2007, 41945 in 2010	52% (both surveys)	• Policy attitudes changed for more supportive since the implementation of policies. • Current and former smokers supported bans less than never smokers but differences decreased over time.
Lykke et al. 2016	Denmark	Cross-sectional, representative of population in Capital region of Denmark	16+	"Do you think it's a good idea to set a date for when smoking in Denmark should be banned (with the possibility of tobacco on prescription for already addicted smokers? No/Yes within 10 years/Yes within 20 years/Yes within 30 years or more)", "Should taxes on tobacco products be increased?"	2013	41356	44 %	• One third of the population supported a future ban on smoking. • The majority of the population supported tobacco tax increases. • Support for future bans and tax increases were greatest among never smokers compared with daily smokers.

Table 4 cont.

Study	Country	Study design	Age range, years	Opinion measure	Study period	Sample size, N	Response rate	Finding
Nieminen et al. 2010	Finland	Cross-sectional, male military conscripts	18–26	"What is your attitude to recent smoking restrictions in Finland, e.g. banning smoking in restaurants, bars, and in all indoor public places?", "How do you react to the following situation: Your neighbour is smoking on his balcony next to yours. You are sitting on your own balcony where the smoke is spreading."	2009	1167	98% (inclusion rate)	• Almost half of the youths supported more restrictive smoking regulations. • Smoking status was strongly associated with attitudes towards smoking restrictions and SHS. • Current smokers and the lower educated opposed recent legislative actions more likely than their counterparts.
Paavola et al. 1991[a]	Finland	Cross-sectional, representative of Finnish population, telephone or face-to-face interviews	15–64	"Smoking at workplaces should be permitted/restricted partly or completely/ do not know"	1988–1990	"About 2300 annually"	85%, 86%, 83%	• Strong support for smoking restrictions at workplaces among employees. • Women supported workplace bans more frequently than men.[b]
Sæbø and Lund 2019	Norway	Cross-sectional, nationally "approximately representative sample by gender, age and region", web and smartphone survey	15+	Support for a smoking ban in cars, on private balconies, in parks and at public transport stops and work entrances.	2014–2015	5543	Not reported	• A majority of respondents supported banning smoking in cars with children present. • High support also among smokers.
Sohlberg 2019	Sweden	Cross-sectional, former smokers	36–89	The attitudes towards 18 existing or proposed tobacco control measures (e.g., bans against smoking in workplaces, bans against smoking in playgrounds, display ban)	2017–2018	705	50 %	• An overall high support especially for smoke-free environments but also for other policy measures. • Nicotine users (snus or NRT) were more opposed to policies concerning sales of tobacco (flavour ban, tax increases, display ban, plain packaging).
Thyrian et al. 2010[c]	Germany, Greece, Poland, Sweden, UK	Cross-sectional, representative, telephone interview	16–59	Attitudes towards smoking bans in 6 settings (e.g., bars, public places), beliefs of the harmfulness of SHS (4 items), support for governmental regulations of smoking (8 items)	2006	3500 (700 per country)	56% (79% for Sweden)	• Non-smokers felt more positive about restrictions than smokers. • Smokers supported most restrictions and regulations.

[a]: Study is in Finnish, translations by OR.

[b]: Not verified statistically.

[c]: Only results from Sweden are described.

Lund (2016) examined the opposition of smokers to 16 potential tobacco control measures in Norway. Findings suggested that smokers accepted regulations that protect others from SHS but at the same time they seemingly defended their right to smoke in some outdoor areas. Another study from Norway concentrated on the attitudes towards smoking in vehicles carrying children and smoking at some outdoor sites, such as public transportation stops (Sæbø and Lund 2019). The results implied that a majority of Norwegians supported banning smoking in cars with children present, including a large support also among smokers. In adjusted models, women and older respondents supported some measures more than men and younger respondents but no association between education and tobacco control measures was observed. Some caution in the interpretation of the results must be preserved, as the authors did not explicitly state which variables were included in the adjusted model.

One Swedish study investigated 36–89-year-old former smokers' attitudes towards existing (for example smoking banned in restaurants and bars) and proposed (for example plain packaging) tobacco control policies (Sohlberg 2019). The author stated that there was an overall support for smoke-free environments but bans against smoking outdoors might have been experienced as intrusive. The results also indicated that former smokers using nicotine tend to be more opposed to these policies compared with non-nicotine users (smokers who had quit smoking and did not use snus or NRT). The number of respondents in the nicotine-user group was limited (n = 54) which restricts further interpretations. A comparative study investigated attitudes towards several smoking-related measures as well as tobacco control opinions in Sweden, the UK, Germany, Poland and Greece (Thyrian et al. 2010). In Sweden, non-smokers were more supportive for smoking bans on different areas, such as workplace, public buildings, and public transportation, than smokers.

Two Danish studies have examined attitudes towards smoking bans and tax increases. The other examined changes in the attitude towards smoking bans in public arenas among adults in the Capital Region of Denmark from 2007 to 2010 (Lykke et al. 2014). The results implied increasing acceptance of restrictions once they have been implemented. In an age- and gender-adjusted model, a supportive attitude was associated with higher educational attainment, non-smoking and intention to quit smoking in restaurants, workplaces and bars. Another study investigated support for a possible future ban on smoking as well as raising tobacco taxes (Lykke et al. 2016). One third of the respondents were supportive of the ban on smoking and the majority of the respondents supported tax increases. Adjusted models (adjusted for sex, age, educational attainment and smoking status) revealed that support for tax increases was higher among women, higher SEP groups and non-smokers. However, the higher SEP groups and smokers were less supportive of a future ban on smoking. Some comparative studies have also included data from Finland and other Nordic countries but have analysed pooled data, for example, at the European level (Lidón-Moyano et al. 2018). No investigations from Iceland on tobacco control opinions were identified for this literature review.

Outside the Nordic countries, studies have reported population attitudes towards novel tobacco control measures and mostly found support. The measures have included such as prohibiting smoking in cars when children are present (Díez-Izquierdo et al. 2017), raising the sale of tobacco to 21 years (Kuijpers et al. 2018), ending the sale of tobacco (Hayes et al. 2014), introducing cigarette pack inserts (Brennan et al. 2020), flavor bans (Agaku et al. 2019; Schmidt et al. 2018), larger cigarette pack warning labels (Kowitt et al. 2017),

menthol and nicotine reduction in cigarettes (Bolcic-Jankovic and Biener 2015), and outdoor smoking restrictions (Kennedy et al. 2012).

Most of the studies on attitudes towards tobacco control policies have included individual statements as the outcome while more holistic measures have been scarcely utilised. In one study, eight attitude items were summed as a sum score with factor analysis of overall support for smoking restrictions and tobacco ad bans (Bakhturidze et al. 2013). Agreement with restrictions was higher with age and was significantly higher among never smokers compared with daily smokers when age, gender, education level and income were adjusted for. Education was only modestly associated – while income was not associated – with restrictions and tobacco ads ban. In another study comparing 27 EU member states, a sum variable indicating societal support for policy measures was constructed based on four different individual statements (Willemsen et al. 2012). The study found that societal support was not associated with stricter tobacco control. A third study utilising a summary measure of policy support was constructed based on 24 items (Raptou et al. 2012). The results indicated that smokers and younger respondents were less likely to support tobacco control policies but education was not associated with the tobacco control measure. A fourth investigation examined 'anti-governmental regulations' and 'pro-governmental regulations', both sum variables based on four items (Thyrian et al. 2010). The means of the scales were compared with an analysis of variance, independent variables being smoking status and nation. Results indicated that non-smokers disagreed with anti-governmental regulations but agreed with pro-governmental regulations more than smokers.

An overall strong support among the population as well as among smokers has been observed in policies considering especially protecting children from the harms of SHS (Kuijpers et al. 2018; Lund 2016; Díez-Izquierdo et al. 2017; Lazuras et al. 2009). Several studies have also shown that population attitudes towards smoking and tobacco control have become more strict (Lidón-Moyano et al. 2018; Pacheco 2011; van Mourik et al. 2018) although some mixed results have been proposed (East et al. 2019). In addition, studies evaluating the possible impact of implemented policies using a pre-post design have consistently found that acceptance of policy measures increases after the implementation of these policies (Hayes et al. 2017; Swift et al. 2015; Hyland et al. 2009). Mons and colleagues (2012) studied the different levels of implementation and found comprehensive smoking bans to be more supported than partial policies.

Taken together, the evidence base for the acceptance of tobacco control measures come from myriad individual studies as well as several both systematic and other reviews. The evidence shows that most of the measures of tobacco control are widely accepted in high-income countries. Especially the regulations protecting children from the harms of SHS are widely accepted. Smoking status is strongly associated with attitudes towards tobacco control policies: non-smokers support the tobacco control policies more than smokers. Some demographic factors, such as older age and female gender seem to be associated with more positive views on tobacco control. The association between SEP and acceptance of tobacco control seem ambiguous and the results from the few conducted Nordic investigations support this view.

3.5 IDENTIFIED GAPS IN THE PREVIOUS RESEARCH

First, there is ample evidence on socioeconomic differences in smoking over the decades which show clear differences between SEP groups: lower SEP groups smoke more frequently than high SEP groups. These results are reported widely across the high-income countries. While smoking is generally declining, the differences between SEP groups seem to be prevailing or increasing because smoking is declining at a more rapid pace among the higher SEP groups. However, only few studies have been able to follow the smoking trends by SEP in a population-based sample more than ten years. Even fewer of these studies come from Europe including the Nordic countries. Investigations on the association between SEP and smoking have been conducted also among the Finnish adult population, but the recent development of this association is unknown.

Second, studies examining differences in smoking by SEP among adolescents show mostly a parallel association as with adults: lower socioeconomic groups smoke more likely than their counterparts. The association between adolescent SEP and snus use is much less studied and the investigations concentrate mostly in one country. Some investigations on male conscripts have been carried out in Finland. The available evidence proposes that the association between SEP and snus use is more ambiguous than the association between SEP and smoking. Considering intergenerational social mobility, prior research have suggested that those adolescents with a lower individual SEP (downwardly mobile, stable low) are more likely to smoke than those with a higher SEP (upwardly mobile, stable high). Furthermore, the offspring's individual SEP seems to be a stronger predictor of smoking than the parental SEP. Only few studies have examined the association between SEP and smoking over time by intergenerational social mobility, and none of them have included snus use.

Third, prior studies imply that a higher SEP is associated with a higher likelihood of smoking cessation. Some longitudinal studies from stop smoking services as well as cross-sectional studies on quit ratios support this view. The evidence from the few conducted general adult population studies is highly mixed. The association between SEP and smoking cessation has rarely been the main objective of the investigations and none of the Finnish or Nordic studies have examined this with a general adult population-based sample. In addition, subjective measures of nicotine dependence are generally utilised: no adult general population study were identified for this review taking advantage of an objective measure of dependence to examine the association between SEP and smoking cessation.

Finally, abundant evidence shows a high support for tobacco control policies. Tobacco control policies and smoking restrictions are widely supported by population and support increases after the policy has been implemented. Some measures are accepted also by smokers although generally non-smokers view restrictions more positively than smokers. Results show an association between some demographic factors, such as gender and age, but the association between SEP and acceptance of tobacco control is less clear. Individual items have generally been used to assess population attitudes towards tobacco control policies while only a handful of investigations have utilised a more holistic approach. There are only few studies examining attitudes on tobacco control with a population-based sample from the Nordic countries, including Finland.

4 AIMS OF THE STUDY

The aim of this study is to improve and elaborate the knowledge of socioeconomic differences in tobacco use and factors contributing to the association in the Finnish population. The study specifically examines smoking and snus use and its changes, smoking cessation and social acceptance of smoking and tobacco control. The sub-studies utilise population-based surveys and health study data.

The specific objectives of the study are to:

1. examine the absolute and relative educational differences and their changes in smoking among adults (I)
2. examine the absolute and relative differences and their changes in smoking and snus use among adolescents by their intergenerational social mobility (II)
3. examine the educational differences in smoking cessation (III)
4. examine the acceptance of smoking and tobacco control (IV).

5 MATERIALS AND METHODS

5.1 DATA SOURCES

This study relies on surveys and health study data. Table 5 presents the characteristics of the samples used in each sub-study.

Sub-study I investigated SEP differences in smoking among adults from 1978 until 2016. In this, the Health Behaviour and Health among the Finnish Adult Population survey was utilised for the years 1978–2014 (Helldán and Helakorpi 2015) and the Regional Health and Well-being Study for the year 2016 was employed (THL 2020b). Health Behaviour and Health among the Finnish Adult Population survey is an annual postal multipurpose survey carried out to obtain information on the health-behaviour of the Finnish working-age population (aged between 15 and 64 years). In addition to smoking, the survey includes questions, for example, about dietary habits, alcohol consumption and physical activity. Annually, a random sample of 5000 Finnish adults was derived from the Population Register and a questionnaire was mailed with three reminders. The response rate for the surveys has declined over the years, from 84% in 1978–1979 to 53% in 2014 (Helakorpi et al. 2000; Helldán and Helakorpi 2015). The Regional Health and Well-being Study is a postal and online survey with the target population aged 20 and above. The objective of the survey is to monitor the welfare and health of the residents in municipalities (THL 2020b). In 2016, a random sample of 5000 Finnish adults was retrieved from Population Register. The response rate was 40% in 2016. No data was available for the year 2015 with comparable measures of smoking.

Adolescent smoking and snus use were investigated in sub-study II during 2008–2017. For this, the upper secondary level data of the School Health Promotion Study was utilised (THL 2020c). The study monitors the well-being, the health and schoolwork of the Finnish children and adolescents, and its objective is to strengthen the planning and evaluation of health promotion activities. The study is being conducted by an anonymous and voluntary classroom-administered questionnaire for the 8th and 9th graders (14–16 years old) in comprehensive school (since 1996), for the 1st-and 2nd-year students (16–18 years old) in general upper secondary school (since 1999), and for the 1st- and 2nd-year students in vocational education institutions (16–20 years old) (since 2008) (Ikonen and Helakorpi 2019). In addition, 4th and 5th graders (9–11 years old) in comprehensive school and their guardians have been included since 2017. The study has been conducted every other year since 2013. Before that, it was implemented in Southern, Eastern and Northern Finland in even-numbered years (excluding 2012) and in Western and Central Finland in odd-numbered years.

Data collection has been gradually changed from a pen and paper survey to an online survey (Ikonen and Helakorpi 2019). The coverage rate was 74–84% for the 8th and 9th graders and 60–76% for the general upper secondary school students in 2000–2013. In 2015–2017, the corresponding coverage rates were 43–63% and 51–64%, respectively. The response rate or the coverage rate for vocational education institutions cannot be estimated reliably due to the lack of national registers data about the target population. Overall, the number of respondents at the secondary education level has varied from N =

91108 in 2008–2009 to N = 61227 in 2017. Most of the respondents in upper secondary education and vocational education are between 16 and 18 years old, age distribution being similar among students in both school types (Ikonen and Helakorpi 2019). In 2019, for example, 47.2% of the students in upper secondary school were 17 years old, while the corresponding proportion for the students in vocational education institutions was 42.9% (Ikonen and Helakorpi 2019).

Table 5 Characteristics of the samples used in the study.

	Sub-study I	**Sub-study II**	**Sub-study III**	**Sub-study IV**
Name of the study	Health Behaviour and Health among the Finnish Adult Population / Regional Health and Well-being Study	School Health Promotion Study	Health 2000 Survey, Health 2011 Survey	The National FINRISK Study
Years included	1978–2016	2008/2009–2017	Baseline: 2000–2001, follow-up: 2011–2012	2012
Study population	25–64-year-old Finnish population	1st- and 2nd-year students at vocational education institutions and at general upper secondary education (predominantly 16–18 years old)	The Finnish population, at least 30 years old at the baseline	25–74-year-old Finnish population
Sampling design	Population-based random sample	School survey	Population-based two-stage stratified sample	Population-based stratified random sample
Analytic sample size	N = 104315	N = 384379	N = 945	N = 4905
Response rate	Varied between 84% and 40%[a]	Varied between 74% and 55%[b]	70%	59%

[a]: The overall response rates. The response rate considering sub-study I may be different due to, for example, different age groups.
[b]: Coverage rate for general upper secondary education. Coverage for the vocational education institutions cannot be reliably estimated.

Population attitudes towards smoking and tobacco control (sub-study IV) were investigated utilising The National FINRISK Study from the year 2012 (Borodulin et al. 2018). This population-based study was conducted from 1972 until 2012 and aimed to monitor non-communicable disease risk factors, health behaviour and their changes (Borodulin et al. 2015). The target population comprised adults aged 25 to 74 years of selected areas (Borodulin et al. 2018). For each survey year, an independent simple random sample was drawn from the National Population Information Systems. The study has utilised questionnaires, health examinations, and biological samples. The total number of invitees varied by study year from N = 13500 in 1972 to N = 7932 in 1987. In 2012, the number of invitees was N = 10000. Over the years, the participation rate has declined gradually, starting from over 90%. In 2012, 57% of men and 67% of women participated in the survey (Borodulin et al. 2018). In 2012, those who took part in the health examination (59%) were given a separate post-examination questionnaire including questions on smoking opinions. The questionnaire was completed at home and returned later by mail.

Smoking cessation was examined with a longitudinal data design in sub-study III. In this, Health 2000 and Health 2011 Surveys were utilised. The Health 2000 Survey is a longitudinal, nationally representative population study that was conducted during 2000–2001 (Heistaro 2008). The aim of the study was to provide an up-to-date account of major public health problems, their causes and treatment (Aromaa 2008). The sample size was 8028 and participants in the main survey were aged 30 or over (Laiho et al. 2008). Several methods were used, such as questionnaires, clinical examinations and determinations from blood samples (Heistaro 2008). All the participants in the Health 2000 Survey who were alive, living in Finland and had not refused to take part in the study were invited to participate in the follow-up study, Health 2011 Survey (Lundqvist and Mäki-Opas 2016). The data was collected between 2011 and 2012 and the number of participants aged 41 or older (at the baseline 30 years or over) was N = 6319 (Härkänen and Virtala 2016). There were three stages of data collection in the follow-up: health examination, phone interview, and a short questionnaire (Lundqvist et al. 2016). Overall, the response rate for respondents aged 41 or older who participated in at least one data collection phase in the follow-up was 76% (n = 4797) (Lundqvist et al. 2016).

5.2 VARIABLES AND MEASUREMENTS

Outcome variables

Smoking and snus use

Smoking, snus use, and smoking cessation were used as the outcome measures in sub-studies I–III. In sub-study IV, smoking status was used as the main predictor variable but it is described in this section for readability.

In sub-study I, SEP differences in smoking during 1978 and 2016 were investigated utilising Health Behaviour and Health among the Finnish Adult Population survey and Regional Health and Well-being Study. Smoking status was measured through the annual prevalence of daily smoking. Smoking status was defined with three (and since 1996 with four) questions following the WHO's recommendations (WHO 1998): 'Have you ever smoked', 'Have you ever smoked daily at least 1 year/How many years?', 'When was the last time you smoked?', and since 1996, 'Have you ever smoked at least 100 times (cigarettes, cigars, pipes)?'. The original variable included categories 'Daily smoker', 'Occasional smoker', 'Quitter 1–12 months ago', 'Quitter over 1 year ago', 'Never smoker', and 'Incomplete data'. Two categories of former smokers were pooled together and those with incomplete data were omitted, so the final variable included four categories 'Daily smoker', 'Occasional smoker', 'Former smoker', and 'Never smoker'. See Appendix 1a for the description of the smoking status variable.

In sub-study II, the association between intergenerational social mobility and tobacco use was examined during 2008–2009 and 2017 using the School Health Promotion Study. Daily smoking and daily snus use prevalence were measured. A daily smoking index was formed of two questions: 'How many cigarettes, pipefuls and cigars have you smoked

altogether?' ('None', 'Just one', 'About 2–50', 'More than 50') and 'Which of the following alternatives best describes your current smoking habits?' ('I smoke once a day or more often', 'I smoke once a week or more often, but not every day', 'I smoke less often than once a week', 'I have quit smoking [temporarily or permanently]'). Those who had smoked at least two cigarettes and smoked at least once a day were classified as daily smokers (Appendix 1b). Respondents who did not answer both of the questions were omitted (n= 442). Snus use was assessed with a question 'Have you ever used snus?' with answer options 'Not at all', 'I have tried it once or twice', 'I use it now and then', 'I use it every day', and 'I used to use it, but I quit'. Those who reported using snus every day were classified as daily users of snus.

In sub-study IV, The National FINRISK Study was utilised to study the acceptance of tobacco control policies. Smoking status was originally assessed with five questions: 'Have you ever smoked' ('No'/'Yes'), 'Have you during your life smoked at least 100 times (cigarettes, cigars or pipefuls)' ('No'/'Yes'), 'Have you ever smoked regularly (almost every day for at least a year)?' ('I have never smoked regularly'/'I have smoked regularly'), 'Do you smoke now (cigarettes, cigars, pipefuls)?' ('Yes, daily'/'Yes occasionally', 'Not at all'), and 'When was the last time you smoked?' ('Yesterday or today', '2 days–1 month', '1 month–6 months', '6 months–1 year ago', '1–5 years ago', '6–10 years ago', 'Over 10 years ago') (Appendix 1d). The original smoking status variable was categorised into six classes: 'Never smoker', 'Former smoker (quit over 6 months ago)', 'Recent quitter (quit 1–6 months ago)', 'Occasional smoker', 'Daily smoker', and 'Other (undefined)'. The index was collapsed into five classes: the 'Other' category was dropped as missing data (n = 49). The term 'nonsmoker' was used to describe never smokers, former smokers, and recent quitters, and the term 'smoker' was used to describe occasional and daily smokers.

Smoking cessation

The association between SEP and smoking cessation was investigated in sub-study III with longitudinal Health 2000 and Health 2011 Surveys. The outcome variable was smoking cessation measured through smoking status at the baseline vs. smoking status at the follow-up. Smoking status at the baseline was assessed using three questions: 'Have you ever smoked during your lifetime?' ('Yes'/'No'), 'Have you smoked at least 100 times during your lifetime (cigarettes, cigars or pipes)?' ('Yes'/'No'), and 'Do you currently smoke (cigarettes, cigars or pipes)?' ('Daily', 'Occasionally', 'Not at all') (Appendix 1c). Three mutually exclusive groups were created: daily smoker, occasional smoker, and non-smoker. Respondents were classified as daily smokers or occasional smokers if they had smoked during their lifetime and they currently smoked daily / occasionally. Respondents were classified as non-smokers if they had not smoked during their lifetime or they had smoked during their lifetime but less than 100 times or they did not smoke currently. Smoking status at the follow-up was assessed using two questions: 'Have you ever smoked during your lifetime?' ('Yes'/'No') and 'Do you currently smoke (cigarettes, cigars or pipes)?' ('Daily', 'Occasionally', 'Not at all'). Again, three mutually exclusive groups were created: daily smoker, occasional smoker, and non-smoker (Appendix 1c). Respondents were classified as daily smokers or occasional smokers if they reported having smoked during their lifetime and currently smoked daily or occasionally. Respondents were classified as non-smokers if they had smoked in their lifetime but did not smoke currently,

or if they had not smoked during their lifetime. Smoking cessation at the follow-up was determined by daily smoking at the baseline and no smoking at the follow-up. Continued smoking was determined as daily smoking both at the baseline and at the follow-up.

Societal acceptance of smoking and tobacco control

The classification of the attitudes towards tobacco control measures has included dichotomies (in favor/not in favour) (Farley et al. 2015), multiple classes ('A good thing', 'A bad thing', 'Neither good nor a bad thing', 'Don't know/Can't say') (Hayes et al. 2014) and five-point Likert scale measures ('Support strongly', 'Somewhat support', 'Neither support nor oppose', 'Oppose somewhat', 'Oppose strongly') (Brennan et al. 2020; Lund 2016). In sub-study IV, tobacco control opinions were collected by means of 25 statements exploring the respondents' attitudes towards tobacco policy and smoking. These statements are presented in Appendix 2. The statements included such as: 'I like the smell of tobacco', 'Smoking on balconies should be forbidden by law', 'Smoking restrictions are enforced sufficiently', and 'Society should support everyone who quits smoking'. The original five-point Likert scale (1 = 'Completely disagree', 2 = 'Somewhat disagree', 3 = 'Neither agree nor disagree', 4 = 'Somewhat agree' and 5= 'Completely agree') was collapsed into three categories: 'Disagree' (completely or somewhat disagree), 'Neutral' (neither agree nor disagree) and 'Agree' (completely or somewhat agree). In order to formulate the outcome variables, principal component analysis was conducted which yielded four components (see also section 5.3 Statistical methods).

Main predictor variables

Education

In sub-studies I–III, education was used as the main predictor variable. Education was included also in sub-study IV as an explanatory variable. For uniformity, it is described in this section.

In sub-study I, relative education was used as an indicator of SEP as the educational level of the Finnish population has drastically changed from the 1970s until the 2010s (Statistics Finland 2019). For each survey year, the self-reported number of years of school was stratified according to tertile cut points, taking into account the gender and the year of birth of the respondent. The lowest tertile (lowest number of years of school) according to birth year was classified as 'Less educated', the middle tertile was classified as 'Middle educated' and the highest tertile was classified as 'Highly educated'. Distributions were created according to gender. The less educated were compared with the highly educated.

In sub-study II, the school type of the participant was used as a proxy for individual-level SEP. General upper secondary education was interpreted as an academically oriented education and vocational education institution was interpreted as a non-academically oriented education. The respondent's SEP was used together with the highest parental education level to compute the variable for intergenerational social mobility (Table 6). The educational level of mother and father were dichotomised to describe 'High education' ('University, university of applied sciences or other higher education institution') or 'Less than high education' ('Comprehensive school or equivalent', 'Upper secondary school, high

school or vocational education institution', 'Occupational studies in addition to upper secondary school, high school or vocational education institution', and (up until 2013) 'No education'). These variables were combined to account for parental education: 'At least one parent has a high level of education', or 'Both parents have a lower level of education'. Academically oriented adolescents with at least one highly educated parent were classified as stable high, and adolescents in an academically oriented educational track with parents with a lower level of education were classified as upwardly mobile. Participants following a non-academic school track with parents with a lower level of education were classified as stable low, whereas non-academically oriented adolescents with at least one highly educated parent were classified as downwardly mobile.

Table 6 Construction of the intergenerational social mobility variable by school type of the adolescent and parental education.

	Parental education	
Adolescent's school type	High[a]	Less than high[b]
Vocational education institution	Downwardly mobile	Stable low
General upper secondary	Stable high	Upwardly mobile

[a]: At least one parent has a high level of education.

[b]: Both parents have a lower level of education.

Sub-study III used a variable for educational level that was based both on the basic education ((from 'less than elementary school' until 'matriculation examination') and the highest education or degree of the respondent (from 'no vocational training' until 'doctoral degree'). Education was classified into three classes: 'Basic education', 'Middle education' and 'High education'.

In sub-study IV, education was used as an explanatory variable. Education was self-reported total years of schooling and was further divided into three groups (low, middle, high) by each birth cohort to take into account the higher level of education among the younger birth cohorts of the population.

Other explanatory variables

Gender was used as an explanatory variable in sub-studies I–IV. Analyses were stratified by gender (by default or in addition to pooled analyses) in sub-studies I, II and III. In sub-study II, differences in snus use were examined among boys only as the prevalence was very low among girls. In sub-studies I–III age was treated as a continuous variable and in sub-study I it was additionally categorised as 25–44 and 45–64 years. In sub-study IV, age was categorised into three classes (25–44 years, 45–64 years, and 65–74 years). In sub-studies I and II, study year was used as a covariate when examining changes in tobacco use over time.

The real price index (= cigarette price index / consumer price index) was used as a covariate when examining trends in smoking (sub-studies I and II). It was interpreted to describe the changes in the cigarette price over time. The data came from the Statistics Finland. The snus price index was used in sub-study II when examining changes in snus

use. As the snus that is being used in Finland comes predominantly from Sweden and because of the geographical proximity of Sweden to Finland, the price of snus and its changes in Sweden were to thought possibly to influence the snus use in Finland. This data was obtained from Statistics Sweden.

Sub-study II included maternal/paternal smoking status ('Has not smoked', 'Has quit', 'Smokes', 'Do not know', 'Did not report') and unemployment of parents during the past 12 months ('At least one parent unemployed', 'Other') as explanatory variables. Sub-study III included employment status ('Employed', 'Unemployed or laid off', 'Retired', 'Other or missing'), marital status ('Living with a partner', 'Living without a partner'), underaged children living in the household ('None', 'At least one'), income per month weighted by the household size relative to the number of children, cigarettes per day (CPD), plasma cotinine level, alcohol consumption (grams/week) classified as 'No use', 'Moderate use', and 'Heavy use' according to gender, self-perceived health ('Good', 'Other'), BMI (weight [kg]/height2 [m2]), and Beck Depression Inventory classified as 'None or minimal depression' (0–9 points), 'Mild depression' (10–18 points), and 'Moderate or severe depression' (19–55 points) as covariates. In addition to education, other explanatory variables in sub-study IV were marital status ('Married, registered partnership, or cohabiting', 'Separated, divorced, or single', 'Widowed') and exposure to second-hand smoke ('Not exposed'/'Exposed to SHS at least one hour per day').

5.3 STATISTICAL METHODS

SPSS 24/25 and Stata SE 15/16 were used in all data management and analyses. In all analyses, a 95% confidence level was applied.

In sub-study I, the linear effect of time points on daily smoking was tested with logistic regression where the survey year was the independent variable. For examining the absolute and relative group differences in smoking between educational groups, the slope index of inequality (SII) and the relative index of inequality (RII) were calculated (Mackenbach and Kunst 1997; Regidor 2004). These summary indices are regression based estimates that measure hierarchical group differences intended to be used in parallel to get a more thorough picture of the phenomenon. Estimating both absolute and relative differences is pivotal when monitoring health inequalities and evaluating policy interventions since a decrease in the frequency of the health problem may result for example in a decrease in the absolute differences but an increase in the relative differences (Regidor 2004). SII expresses the SEP differences between the top and bottom of the hierarchy as rate differences while RII expresses the difference as rate ratios (Mackenbach and Kunst 1997). RII values above 1.0 and SII values above 0 imply higher smoking prevalence among the lower SEP groups than among the higher socioeconomic groups (Lahelma et al. 2016). Large scores for RII and SII imply large differences in a given outcome between high and low SEP groups (Mackenbach and Kunst 1997). For computing SII and RII estimates, educational groups by gender and survey year were given a decreasing value from 1.000 to 0.000, according to the age-adjusted prevalence of the relative educational level. The calculated measure (ridit score) was then used as an independent variable in an age-adjusted generalized least-squares model. The analyses

were stratified by gender and survey year. For testing the trend in SII and RII over time between socioeconomic groups, survey year and the interaction variable between survey year and ridit score were included in the model. All the trend analyses were restricted to the years 1981–2016 as the real price index was obtainable only during this period.

Also in sub-study II, the linear effect of time points on daily smoking and daily snus use was tested with logistic regression. For this analysis, study year as a continuous variable was used as the independent variable. The analyses were stratified by gender and social mobility class. Both absolute and relative differences in tobacco use were calculated to examine whether the differences between mobility groups changed over time. Absolute changes were calculated as percentage point changes in tobacco use within a social mobility group. Relative changes were calculated as prevalence ratios between the social mobility groups (group with the highest prevalence in a given study year divided by the group with the lowest prevalence in a given study year). The multiple adjusted associations of smoking and snus use with intergenerational mobility were analysed with binary logistic regression. Model 1 included social mobility, age and the study year. Model 2 was additionally adjusted for the smoking status of parents and parental unemployment. The real price index for cigarettes (only for daily smoking) and the snus price index (only for daily snus use) were added to the next model (Model 3). In the Model 4, interaction term between study year and social mobility class was introduced to test whether smoking and snus use differed between the social mobility classes according to time (not shown on Table 8 and Table 9, see the original article for these results).

In sub-study III, binary logistic regression models were used to examine the associations between the background variables and smoking cessation. Model 1 was adjusted for age. In Model 2, demographic variables (gender, education, employment status, marital status, the number of underaged children living in the household and income) were included. Model 3 was further adjusted for health-related variables (CPD, plasma cotinine level, alcohol consumption, self-perceived health, and BMI). In the final model (Model 4), the measure for depression symptoms was included. The interaction term between education and gender was tested to assess if the association between education and smoking cessation differed between genders. Additionally, the amount of confounding[11] of the background variables on the association between education and smoking cessation was assessed with the reformulated Karlson–Holm–Breen (KHB) method (Breen et al. 2018). In this analysis, a latent index (estimated linear predictor) of a nonlinear probability model is used to estimate the extent of confounding of the selected variables on the association between the outcome and the predictor (Breen et al. 2018).

Sub-study IV included principal component analyses to compress any possible underlying components for tobacco policy views. Both Kaiser-Meyer-Olkin measure ($p = 0.767$) and Bartlett's test of sphericity ($p<0.001$) suggested that principal component analysis was appropriate to conduct (Metsämuuronen 2009, pp. 656, 660). Oblique rotation (Promax) was chosen, as the components could be related to each other and it gave the best interpretative solution of the conducted principal component analyses. Some statements were omitted based on the reliability analysis. The range (absolute value) for the factor loadings of the variables included in the analyses was [0.462, 0.967]. The reliability of the components was assessed using Cronbach's alpha. It was acceptable for

[11] The term 'confound' is being used instead of 'mediate' to imply less causal relationships among the variables (see MacKinnon et al. 2000).

three variables ($\alpha > 0.7$) but also the variable for which the reliability was less than adequate ($\alpha = 0.544$) was included in further analysis because of the content-related interest that the measure provided. These four components were categorised into three classes ('High', 'Neutral' and 'Low') and these classified variables were used as the dependent variables in multinomial logistic regression models. The models were adjusted for all the variables in the study (smoking status, age, gender, education, marital status and exposure to SHS, alcohol use, and income).

5.4 ETHICAL APPROVAL

The protocols of the surveys used in sub-studies I and II were accepted by the Institutional Review Board of National Institute for Health and Welfare. The studies used in sub-study III were approved by the Ethics Committee for Epidemiology and Public Health in the Hospital District of Helsinki and Uusimaa and by the Coordinating Ethics Committee of the Hospital District of Helsinki and Uusimaa. The protocol of the study used in sub-study IV was approved by the Co-ordinating Ethics Committee of the Hospital District of Helsinki and Uusimaa.

6 RESULTS

6.1 ASSOCIATION BETWEEN EDUCATION AND SMOKING AMONG ADULTS IN 1978–2016 (I)

The association between education and smoking among adults during 1978 and 2016 was examined in sub-study I. The outcome measure was daily smoking. Smoking among the less educated was more prevalent during the entire study period compared with the highly educated among both genders (Figure 4, Figure 5).

Decreasing trends for daily smoking over time for men and women among different educational groups were statistically significant (Table 7). Adjusting for the real price index only slightly affected the association between education and smoking among women and among the highly educated men, but it did explain the association among the less educated men. Because the trends for the less educated women seemed to change in the early 2000s, the trend analyses were conducted separately for the years 2001–2016 (Table 7, Panel B). Decreasing trends were observed among both genders. The lower estimates (further away from OR = 1.00) for the decreasing trend among the less educated men in 2001–2016 compared with the estimates for the entire study period suggested a steeper decrease in smoking during the 2000s. For women, on the contrary, a steeper decrease was observed among the highly educated during the 2000s. In the 2000s, the adjustment for the real price index explained the association between the less educated and decreasing smoking trends.

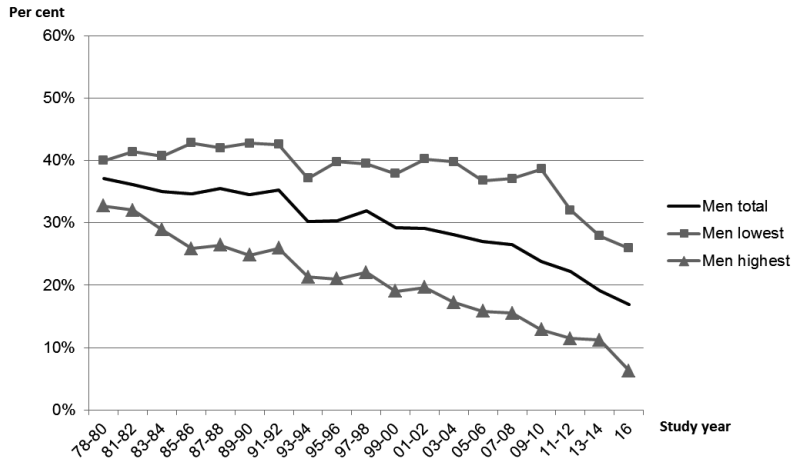

Figure 4 Daily smoking by education, men, 25–64 years, age-adjusted, 1978–2016.

[Adapted from Ruokolainen et al. 2019 (sub-study I)]

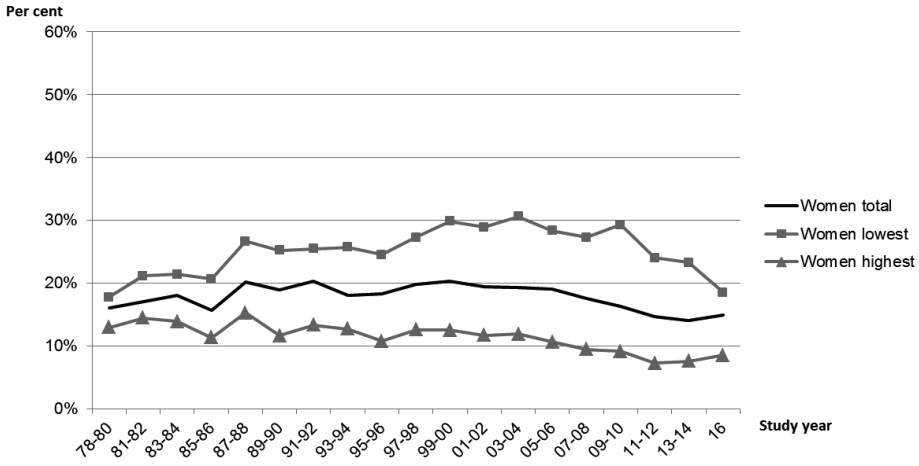

Figure 5 Daily smoking by education, women, 25–64 years, age-adjusted, 1978–2016.

[Adapted from Ruokolainen et al. 2019 (sub-study I)]

Table 7 Logistic regression models for trend for daily smoking in 1981–2016 (Panel A) and in 2001–2016 (Panel B) by gender and educational level. Age-adjusted odds ratios and their 95% confidence intervals, 25–64 years.

	Panel A: 1981–2016		Panel B: 2001–2016	
	Lowest	Lowest[a]	Lowest	Lowest[a]
Men	0.65*** (0.57–0.74)	0.75 (0.48–1.17)	0.25*** (0.15–0.42)	0.36 (0.11–1.16)
Women	0.19*** (0.11–0.32)	0.15*** (0.09–0.28)	0.35*** (0.21–0.56)	0.53 (0.17–1.62)
	Highest	Highest[a]	Highest	Highest[a]
Men	0.26*** (0.22–0.30)	0.21*** (0.12–0.36)	0.12*** (0.06–0.22)	0.17* (0.04–0.75)
Women	0.52*** (0.44–0.62)	0.36** (0.19–0.67)	0.21*** (0.10–0.44)	0.16* (0.03–0.77)

[a]: Adjusted for the real price index.

*: p<0.05; **: p<0.01; ***: p<0.001.

[Adapted from Ruokolainen et al. 2019 (sub-study I)]

During the 1978–2016 period of study, both absolute and relative differences in smoking increased among both genders (p<0.001) (Figure 6). From the beginning to the end of the study period, absolute differences among men increased just short of threefold and among women just short of fourfold. Corresponding increases in relative differences were by a magnitude of four and two, respectively. Absolute differences between educational groups seemed to be greater among men while relative differences were greater among women. Wider confidence intervals in the last study year indicated that the smaller number of observations could have influenced these estimates (for example RII for men in 2016: 5.24, 95% CI 2.41–11.39). An increasing trend for absolute and relative

differences in smoking was also observed when the real price index was included in the model.

In sum, smoking among the less educated was more common than among the highly educated. There has been an overall decline in smoking, yet both absolute and relative educational differences have increased. Changes in cigarette price seemed to have an impact, especially on the trends among the less educated smokers.

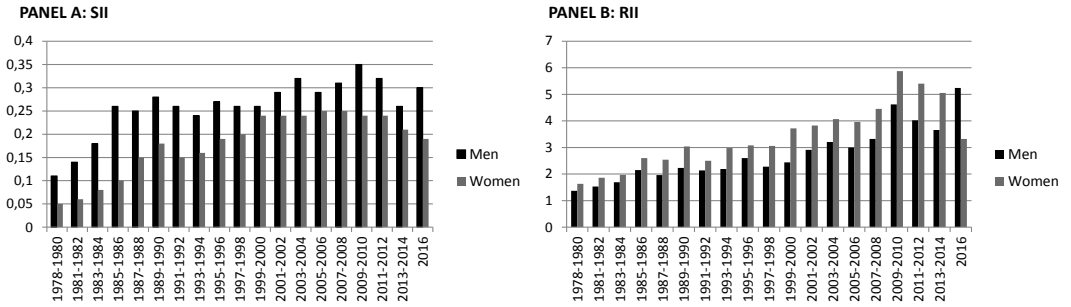

Figure 6 Slope index of inequality (SII, Panel A) and relative index of inequality (RII, Panel B) in 1978–2016 among men and women, age-adjusted, 25–64-year olds.

[Based on Ruokolainen et al. 2019 (sub-study I)]

6.2 ASSOCIATION BETWEEN INTERGENERATIONAL SOCIAL MOBILITY AND TOBACCO USE AMONG ADOLESCENTS IN 2008–2017 (II)

In sub-study II, the association between intergenerational social mobility and adolescent smoking and snus use and their changes during 2008–2017 was investigated. The outcome measures were daily smoking and daily snus use, the latter studied only among boys since snus use among girls was almost nonexistent (0.4%).

Daily smoking decreased during the study period by a half, from 23% to 12%. Smoking was more prevalent among adolescents in vocational education institutions compared with adolescents in general upper secondary education. There were clear differences in smoking by intergenerational social mobility classes: smoking was the least common among the stable high group and only slightly more prevalent among the upward mobile group. Prevalence was less than 5% for both groups in 2017. Smoking rates among the downwardly mobile and among the stable high groups were also markedly close to each other, even over eight times higher than among the academically oriented adolescents.

Daily smoking decreased in all the intergenerational social mobility classes among both genders (for trend $p<0.001$) (Figure 7). Absolute changes in smoking rates over time

showed the steepest decrease within the downwardly mobile group (22% for boys, 16% for girls), indicating a decrease in absolute SEP differences in smoking. However, relative differences between social mobility groups widened during the study period: the prevalence ratio for boys increased from 3.95 to 8.94, and for girls from 4.05 to 8.68. Looking at Figure 7, SEP differences by school type are clearly visible: academically oriented respondents (stable high, upwardly mobile) and non-academically oriented adolescents (stable low, downwardly mobile) formed two distinct groups with rather similar trends within each school type.

Among boys, 4% used snus daily at the start of the period and the rate increased to 13% in 2017. The increase was statistically significant for all social mobility groups ($p<0.001$ for the trend). However, during 2015–2017 the increase plateaued among the academically oriented groups continuing only among the vocationally oriented groups (Figure 8). Both absolute and relative socioeconomic differences increased in snus use: the absolute increase among the downwardly mobile group was greater (14%) than the increase in the other groups (stable low 12%, upwardly mobile 3%, stable high 4%) and the relative differences increased from 1.80 in 2008–2009 to 3.02 in 2017.

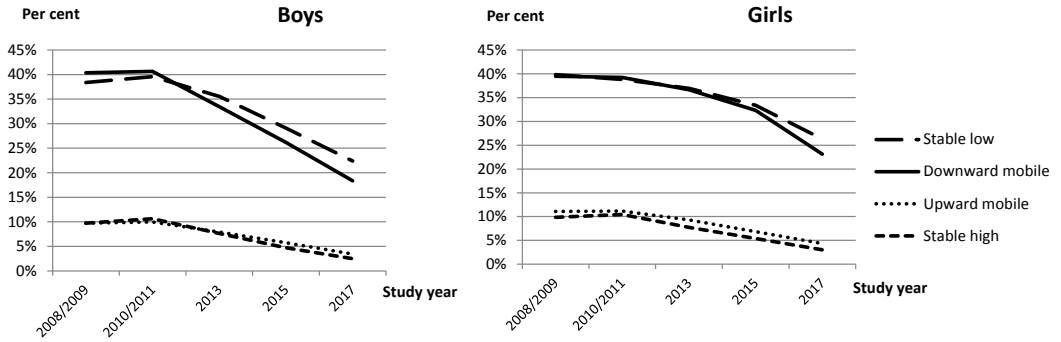

Figure 7 Daily smoking among intergenerational educational groups, boys and girls, 2008–2017.

[Adapted from Ruokolainen et al. 2019 (sub-study II)]

The association between intergenerational social mobility and tobacco use was further examined with multiple adjusted logistic regression models (Table 8). Smoking was more probable among the stable low and among the downwardly mobile adolescents when compared with the stable high adolescents across the models. The adjustment for background variables attenuated the association only modestly. In the final model without the interaction term (Model 3), the odds for smoking among the stable low group was over four times greater, and among the downwardly mobile group over five times greater compared with the stable high group. Smoking was less likely among the upwardly mobile adolescents when compared with the stable high adolescents.

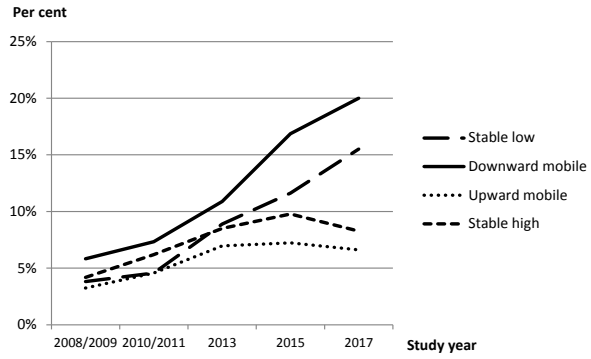

Figure 8 Daily snus use by intergenerational social mobility among boys, 2008–2017.

[Adapted from Ruokolainen et al. 2019 (sub-study II)]

The estimates for intergenerational mobility groups among boys showed similar but weaker associations with daily snus use than with daily smoking (Table 9). Compared with the stable high group, the upwardly mobile adolescents were less likely to use snus, but adolescents in the downwardly mobile group were more likely to use snus (Model 3). Adjustment for background variables modestly attenuated the association between snus use and social mobility groups.

The change over time in smoking and snus use indicated a difference among social mobility groups based on the interactions between intergenerational social mobility and the study year ($p<0.001$ for all). However, analyses stratified by study year showed generally similar associations between social mobility and tobacco use.

To conclude, there were vast differences among intergenerational social mobility groups in tobacco use. Non-academically oriented adolescents were at elevated risk for smoking and snus use but some differences between groups based on the adolescents' individual SEP were detected. Relative differences in smoking between social mobility groups have increased whereas differences in snus use among boys have increased both in absolute and in relative terms. Individual, parental and price-related background variables attenuated the association between intergenerational social mobility and tobacco use only modestly.

Table 8 Association between intergenerational social mobility and daily smoking among boys and girls, 2008–2017. Odds ratios (OR) and their 95 % confidence intervals (95% CI).

	Boys (n = 184250)					
	Model 1[a]		Model 2[b]		Model 3[c]	
	OR	95% CI	OR	95% CI	OR	95% CI
Intergenerational social mobility						
Stable high	1.00		1.00		1.00	
Upwardly mobile	1.05	1.00–1.10	0.85***	0.81–0.89	0.85***	0.81–0.90
Downwardly mobile	6.08***	5.83–6.34	5.20***	4.98–5.43	5.24***	5.02–5.46
Stable low	6.37***	6.14–6.61	4.64***	4.47–4.82	4.68***	4.51–4.86

	Girls (n = 200129)					
	Model 1[a]		Model 2[b]		Model 3[c]	
	OR	95% CI	OR	95% CI	OR	95% CI
Intergenerational social mobility						
Stable high	1.00		1.00		1.00	
Upwardly mobile	1.20***	1.15–1.25	0.92***	0.89–0.96	0.93**	0.89–0.97
Downwardly mobile	6.50***	6.22–6.78	5.45***	5.21–5.69	5.48***	5.24–5.73
Stable low	6.69***	6.47–6.92	4.52***	4.36–4.68	4.56***	4.40–4.72

[a]: Adjusted for age and study year.

[b]: Model 1 + smoking of mother/father, unemployment of parents.

[c]: Model 2 + the real price index for cigarettes.

*: p<0.05; **: p<0.01; ***: p<0.001.

[Adapted from Ruokolainen et al. 2019 (sub-study II)]

Table 9 Association between intergenerational social mobility and daily snus use among boys, 2008–2017. Odds ratios (OR) and their 95 % confidence intervals (95% CI), N = 184 250.

	Model 1[a]		Model 2[b]		Model 3[c]	
	OR	95% CI	OR	95% CI	OR	95% CI
Intergenerational social mobility						
Stable high	1.00		1.00		1.00	
Upwardly mobile	0.78***	0.73–0.82	0.73***	0.69–0.77	0.73***	0.69–0.78
Downwardly mobile	1.68***	1.60–1.77	1.56***	1.49–1.64	1.57***	1.50–1.66
Stable low	1.15***	1.10–1.20	1.03	0.98–1.08	1.04	1.00–1.09

[a]: Adjusted for age and study year.

[b]: Model 1 + smoking of mother/father, unemployment of parents.

[c]: Model 2 + snus price.

*: p<0.05; **: p<0.01; ***: p<0.001.

[Adapted from Ruokolainen et al. 2019 (sub-study II)]

6.3 ASSOCIATION BETWEEN EDUCATION AND SMOKING CESSATION (III)

In sub-study III, the association between education and smoking cessation with a longitudinal population-based study was examined. Baseline data were gathered during 2000–2001 and follow-up data were gathered during 2011–2012. The outcome measure was daily smoking cessation and the main predictor was educational level. The confounding effect of demographic and health-related background variables on the association between education and smoking cessation was assessed, as was the association between background variables and smoking cessation. In the analyses, the sampling design was accounted for.

Daily smoking prevalence was 21% at the baseline (26% for men and 17% for women). Of the baseline daily smokers, 28% had quit smoking by the follow-up; 31% of men and 25% of women. The follow-up quitters tended to be higher educated than the follow-up smokers (p= 0.1078 for pooled data by gender; see also Figure 9). The follow-up quitters were older than continued smokers (46.8 years vs. 43.3 years; p<0.001), and men were more over-represented among the quitters (62% vs. 39%) than among the continued smokers (54% vs. 46%) (p= 0.029).

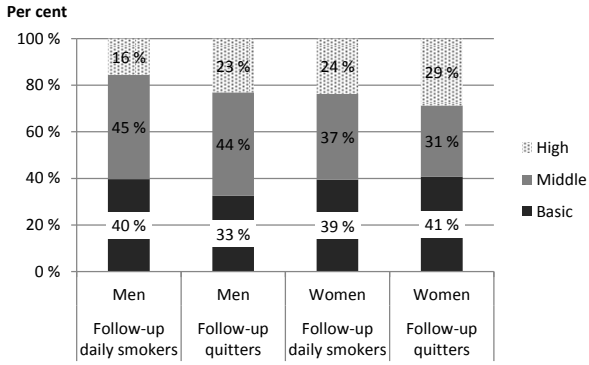

Figure 9 Baseline educational level by follow-up smoking status, men and women. Follow-up daily smokers N = 306 (men) and N = 298 (women), follow-up quitters N = 167 (men) and N = 113 (women).

[Based on Ruokolainen et al. 2020 (sub-study III)]

The association between education and smoking cessation was examined with binary logistic regression analyses. The results showed that the highly educated were more likely to stop smoking compared with the least educated (age-adjusted OR = 1.75, 95% CI 1.22–2.50). There were only modest changes in the association between education and smoking cessation due to adjustment for demographic and health-related variables. Further adjustment for depression symptoms attenuated the association only modestly, resulting in 60% higher odds of quitting smoking in the highest educational class compared with the

least educated (OR = 1.62, 95% CI 1.05–2.50). All the selected background variables decreased the effect of high education and middle education on smoking cessation by 35% and by 47%, respectively.

Figure 10 depicts the association between education and selected background variables with smoking cessation in the final model where all the background variables were adjusted for. Those with middle education had about 20%–30% higher odds for stopping smoking than the least educated throughout the models, yet this association fell short of statistical significance. Considering other covariates, male gender and older age predicted smoking cessation, whereas higher levels of plasma cotinine, heavy use of alcohol and moderate or severe depression symptoms were associated with a lower likelihood of smoking cessation independently of the educational level.

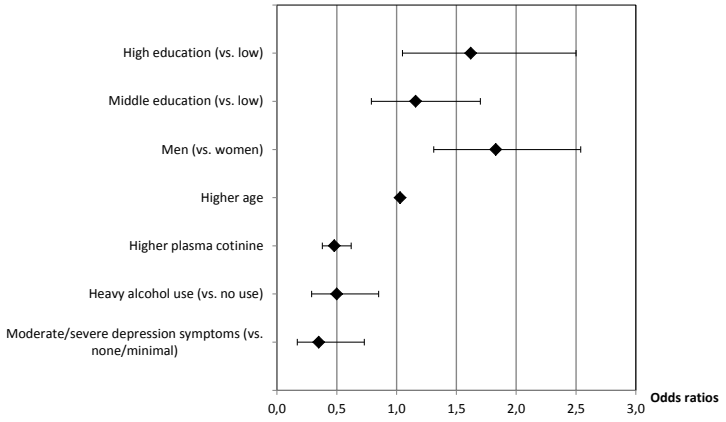

Figure 10 The association between smoking cessation and baseline background variables, adjusted odds ratios and 95% confidence intervals. Model adjusted for all the variables in the figure + employment status, amount of underaged children living in the household, income, CPD, self-perceived health, and BMI.

[Based on Ruokolainen et al. 2020 (sub-study III)]

The interaction term between education and gender was statistically significant (p=0.0014), indicating that the association between education and smoking cessation was different for men and women. Stratified analysis by gender showed that education was associated with smoking cessation only among men (Table 10). When all the background variables were adjusted for, smoking cessation was over two times more likely among the highly educated compared with those with only basic education (OR = 2.08, 95% CI 1.09–3.98). Middle education showed a tendency to increase the odds for smoking cessation, but this association failed to reach statistical significance. Among women, education and smoking cessation showed generally parallel, only weaker associations than among men. Higher levels of plasma cotinine were the only, yet rather strong predictor, of smoking cessation among women throughout the models (final model: OR = 0.42, 95% CI 0.26–0.69). In addition to higher levels of plasma cotinine, heavy use of alcohol and moderate or severe depression symptoms were also associated with smoking cessation among men.

Table 10. Association between education and other baseline background variables with smoking cessation in the follow-up by gender. Odds ratios (OR) and their 95% confidence intervals (95% CI).

	PANEL A: MEN						PANEL B: WOMEN					
	Model 1[a]		Model 2[b]		Model 3[c]		Model 1[a]		Model 2[b]		Model 3[c]	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
DEMOGRAPHIC VARIABLES												
Education tertiles												
Basic	1.00		1.00		1.00		1.00		1.00		1.00	
Middle	1.56	1.00–2.44	1.52	0.97–2.38	1.49	0.89–2.48	0.98	0.60–1.62	1.02	0.59–1.75	0.94	0.52–1.71
High	2.01**	1.22–3.32	1.99*	1.15–3.43	2.08*	1.09–3.98	1.52	0.84–2.74	1.75	0.93–3.27	1.41	0.74–2.69
HEALTH–RELATED VARIABLES												
Cigarettes per day	0.98*	0.96–1.00			0.99	0.96–1.01	0.95**	0.92–0.98			0.97	0.94–1.00
Plasma cotinine[d]	0.54***	0.41–0.71			0.53***	0.40–0.72	0.34***	0.22–0.54			0.42**	0.26–0.69
Alcohol consumption												
No use	1.00				1.00		1.00				1.00	
Moderate use	0.82	0.46–1.45			0.52	0.27–1.00	0.95	0.59–1.54			1.04	0.59–1.83
Heavy use	0.47*	0.25–0.87			0.30**	0.14–0.61	0.68	0.29–1.61			0.95	0.37–2.45
Depression symptoms												
None/minimal	1.00				1.00		1.00				1.00	
Mild	0.93	0.52–1.64			0.79	0.42–1.49	0.72	0.42–1.25			0.72	0.40–1.29
Moderate/severe	0.23**	0.09–0.59			0.28*	0.10–0.81	0.40	0.16–1.02			0.47	0.17–1.29

[a]: Adjusted for age.

[b]: Model 1+ adjusted for education, employment status, marital status, amount of underaged children living in the household, and income.

[c]: Model 2 + adjusted for cigarettes per day, plasma cotinine level, alcohol consumption, self–perceived health, BMI, and depression symptoms.

[d]: OR per an increment of one quintile; the cut-off points were 2, 7, 14 and 220.

*: p<0.05; **: p<0.01; ***: p<0.001.

[Based on Ruokolainen et al. 2020 (sub-study III)]

The results from sub-study III showed that high education was associated with smoking cessation among men. Higher baseline plasma cotinine levels were strongly associated with decreased likelihood of smoking cessation among both genders. In addition, heavy use of alcohol and greater depression symptoms were associated with a lower probability of smoking cessation among men. Several demographic and health-related background variables decreased the effect of education and smoking cessation modestly.

6.4 SOCIETAL ACCEPTANCE OF TOBACCO CONTROL (IV)

In sub-study IV, societal acceptance of smoking and tobacco control was investigated. In descriptive analyses, 15 individual statements (out of 25 statements) exploring the respondents' attitudes towards smoking and tobacco control was examined by smoking status. To construct the dependent variables in the regression models, a principal component analysis was conducted yielding four components ('Pro tobacco control', 'Sufficiency of enforcement of the Tobacco Act', 'Anti-smoking ban at work', 'Societal support for quitters'). The main predictor in sub-study IV was smoking status encoded into five classes ('Daily smoker', 'Occasional smoker', 'Recent quitter', 'Former smoker', 'Never smoker').

Figure 11 illustrates the acceptance rates of four individual statements by smoking status, representing the four components described above. Overall, the attitudes towards different tobacco control measures seemed to follow a gradient-like association with smoking status. Some variation on the level of acceptance was observed between the individual measures. Restricting the number of places where tobacco is sold was predominantly supported (Panel A), whereas the smoking of health care personnel during working hours was accepted to a lesser degree (Panel C). A minority of the respondents agreed that smoking restrictions are enforced sufficiently, daily smokers supported this the most while never smokers supported this measure the least (Panel B). A similar pattern concerning societal support for quitters was observed (Panel D). Of daily smokers, 59% agreed that society shloud support everyone who quits smoking, while less than 40% of never smokers agreed with the statement. The level of support for this measure was less than half for the total population.

Some statements were largely supported among the population and also among the smokers. This was evident in the support of restricting youth tobacco use: 92% of the population supported this, 85% of daily smokers and 94% of never smokers, respectively.

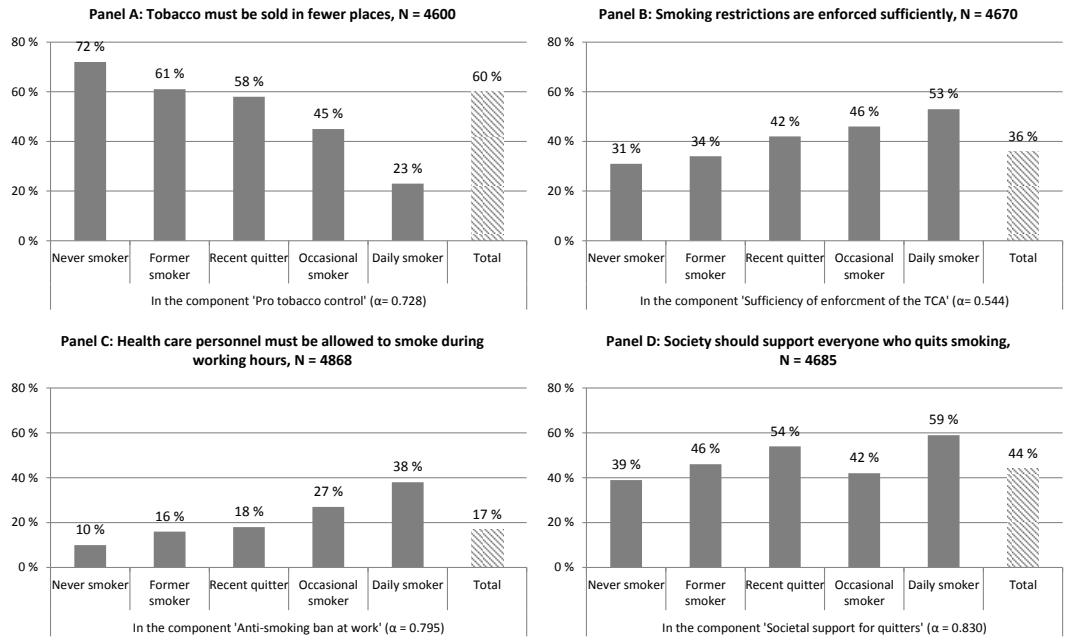

Figure 11 Tobacco control policy statements by smoking status, % of those who somewhat agreed or completely agreed with the statement.

[Based on Ruokolainen et al. 2018 (sub-study IV)

All the background variables were adjusted for simultaneously in the multiple adjusted regression models. In the models, high and low groups were compared (neutral group omitted from the table, see the original article for these results). Compared with daily smokers, all the other smoking status groups supported tobacco control to a greater extent (Table 11, Panel A). There was no difference in the support for tobacco control between educational groups. Other smoking status groups were more dissatisfied with the enforcement of the TA compared with daily smokers (Table 11, Panel B). The least educated were more dissatisfied with the enforcement of the TA compared with the highly educated, the difference being borderline significant (OR = 1.20, 95% CI 1.00–1.44).

All the other smoking status groups viewed workplace bans more positively than daily smokers (Table 12, Panel A). A lower educational level was associated with higher levels of support for workplace bans compared with the high education (OR = 0.77, 95% CI 0.63–0.95). Younger age and male gender were associated with less support for workplace smoking bans. Non-smokers' and occasional smokers' attitudes towards societal support for quitting smoking were generally more negative than the attitudes of daily smokers (Panel B). Other educational groups had a more negative view on supporting quitters compared with the highly educated but, again, the differences did not reach statistical significance (low education OR = 1.20, 95% CI 1.00–1.44; middle education OR = 1.18, 95% CI 0.99–1.41).

Table 11 Associations of smoking status and sociodemographic variables with support for tobacco control and sufficiency of enforcement of the Tobacco Act, adjusted odds ratios (OR) and their 95% confidence intervals (95% CI).

	PANEL A			PANEL B		
	Support for tobacco control (low vs. high)			Sufficiency of enforcement of the Tobacco Act (insufficient vs. sufficient)		
Variables	% (n)[a]	OR[b]	95% CI	% (n)[a]	OR[b]	95% CI
Smoking status						
Never smoker	49 (2321)	0.00***	0.00–0.01	49 (2318)	2.73***	2.17–3.45
Former smoker	29 (1359)	0.01***	0.01–0.02	29 (1359)	2.35***	1.84–3.00
Recent quitter	2 (95)	0.04***	0.02–0.10	2 (95)	2.28**	1.34–3.89
Occasional smoker	7 (324)	0.13***	0.05–0.30	7 (324)	1.44*	1.02–2.02
Daily smoker	13 (627)	1.00		13 (626)	1.00	
Age						
25–44	31 (1493)	1.40**	1.09–1.79	31 (1493)	1.34**	1.10–1.63
45–64	43 (2075)	0.87	0.69–1.10	43 (2074)	1.11	0.92–1.33
65–74	25 (1213)	1.00		25 (1209)	1.00	
Gender						
Men	46 (2177)	1.87***	1.56–2.25	46 (2175)	0.90	0.78–1.05
Women	55 (2604)	1.00		55 (2601)	1.00	
Education						
Low	33 (1548)	1.02	0.81–1.29	33 (1547)	1.20	1.00–1.44
Middle	33 (1557)	0.92	0.74–1.15	33 (1556)	1.15	0.97–1.38
High	34 (1615)	1.00		34 (1613)	1.00	
N	4477			4473		

[a]: From the univariate associations (not shown in the table). The total proportion may not add up to 100% because of rounding.
[b]: Adjusted for all the variables in the table + marital status, exposure to secondhand smoke, alcohol use and income
*: p<0.05; **: p<0.01; ***: p<0.001.

[Adapted from Ruokolainen et al. 2018 (sub-study IV)]

The results from this study showed that tobacco control is largely accepted in the Finnish society. There were differences on the acceptance of tobacco control especially among smoking status groups but also among sociodemographic groups. Society's support for smokers to quit was not widely supported and non-smokers were the least supportive of this measure. There was also an indication that the lower educated are less supportive of this measure than the highly educated. Generally, education associated only modestly with the acceptance of tobacco control.

Table 12 Association of smoking status and sociodemographic variables with support for workplace smoking bans and societal support for quitters, adjusted odds ratios (OR) and their 95% confidence intervals (95% CI).

	PANEL A			PANEL B		
	Support for workplace bans (low vs. high)			Societal support for quitters (low vs. high)		
Variables	% (n)[a]	OR[b]	95% CI	% (n)[a]	OR[b]	95% CI
Smoking status						
Never smoker	49 (2315)	0.05***	0.04–0.08	49 (2311)	3.36***	2.64–4.27
Former smoker	29 (1356)	0.10***	0.07–0.15	29 (1355)	2.21***	1.72–2.84
Recent quitter	2 (95)	0.17***	0.08–0.33	2 (95)	1.29	0.74–2.26
Occasional smoker	7 (324)	0.25***	0.15–0.41	7 (323)	2.00***	1.41–2.83
Daily smoker	13 (626)	1.00		13 (624)	1.00	
Age						
25–44	31 (1491)	5.06***	4.00–6.39	31 (1489)	1.25*	1.02–1.53
45–64	43 (2069)	1.75***	1.42–2.17	43 (2069)	1.06	0.88–1.28
65–74	25 (1211)	1.00		25 (1204)	1.00	
Gender						
Men	46 (2173)	1.82***	1.54–2.15	46 (2172)	1.22**	1.05–1.42
Women	54 (2598)	1.00		54 (2590)	1.00	
Education						
Low	33 (1544)	0.77*	0.63–0.95	33 (1539)	1.20	1.00–1.44
Middle	33 (1554)	0.88	0.72–1.06	33 (1551)	1.18	0.99–1.41
High	34 (1612)	1.00		34 (1621)	1.00	
N	4467			4462		

[a]: From the univariate associations (not shown in the table). The total proportion may not add up to 100% because of rounding.

[b]: Adjusted for all the variables in the table + marital status, exposure to secondhand smoke, alcohol use and income

*: p<0.05; **: p<0.01; ***: p<0.001.

[Adapted from Ruokolainen et al. 2018 (sub-study IV)]

7 DISCUSSION

The objective of the study was to increase and elaborate the knowledge of socioeconomic differences in tobacco use and factors relating to it in the Finnish population. The study specifically examined educational differences in tobacco use and its changes, smoking cessation, and social acceptance of smoking and tobacco control.

7.1 MAIN RESULTS OF THE STUDY

The primary results of the study are fivefold. First, smoking has decreased over time among men and women and among adults and adolescents, yet a significant proportion of the population still smoke. Second, there are marked educational differences in smoking as the less educated smoke more commonly than the highly educated. This is clearly already observable among the adolescents. The decrease in smoking rates has been less pronounced for the low educational groups, thus leading to increased educational differences in smoking.

Third, contrary to the changes in smoking, an increase in snus use was detected among boys. The increase was greater among the non-academically oriented adolescents than the academically-oriented adolescents, resulting in widening socioeconomic differences in snus use. Fourth, education was a strong predictor of smoking cessation among men: the highly educated were more likely to quit smoking than the less educated. Especially, higher scores for cotinine level (indicating higher nicotine dependence), as well as depression symptoms and heavy use of alcohol were associated with continued smoking. The association between education and smoking cessation was similar among women than among men, only weaker.

Last, examination of the attitudes towards smoking and tobacco control revealed that the Finnish adult population is willing to restrict the availability and the overall status of tobacco in society. Smoking status was strongly associated with the acceptance of different policies and measures. While the acceptance was the greatest among non-smokers, smokers also supported some restrictive policy measures. Although the acceptance of tobacco control varied by some demographics, differences between educational groups in support for tobacco control were seldom marked.

7.2 INTERPRETATION OF THE RESULTS AND COMPARISON TO EARLIER STUDIES

Socioeconomic differences in tobacco use – changes and associations (I, II)

Adults

The current study corroborates the earlier widely acknowledged finding that those with lower SEP smoke more commonly than those with higher SEP (Hiscock et al. 2012a). The results also support several previous observations that inequalities in smoking have increased (Agaku et al. 2020; Hoebel et al. 2018; Sandoval et al. 2018; Hu et al. 2017; Lahelma et al. 2016). In line with the current study, earlier investigations examining both absolute and relative inequalities in adult smoking have proposed increases in both estimates (Chang et al. 2019; Sandoval et al. 2018; Ernstsen et al. 2012). However, some variation in the results can be observed (Hoebel et al. 2018; Lahelma et al. 2016), which may be due to different study populations or different stages in the cigarette epidemic model (Lopez et al. 1994; Thun et al. 2012).

Finland was at the end of stage 3 of the cigarette epidemic model around 1990 (Lopez et al. 1994; Mackenbach 2006, p. 36). The fourth stage was characterised by decreasing smoking rates and potentially increasing SEP differences (Lopez et al. 1994). Among men in Finland, smoking has decreased among both the high and the lower SEP groups during the 2000s and the differences between these groups have not only remained but increased. Thus, Finnish men seem to have reached the proposed fifth stage of the tobacco epidemic model (Dixon and Banwell 2009). According to the smoking epidemic model, women in developed countries follow men in the changes in smoking rates some decades later (Thun et al. 2012). Among women, there has been a decrease in smoking among the lower and the higher socioeconomic groups in the 2000s, but the decrease has been steeper among the high SEP group. The relative differences, especially, seem to have also increased in the 2000s (see Figure 6). Thus, entering the 2010s, Finnish women seem to have been at the end of the fourth stage or at the fifth stage of the cigarette epidemic model.

Systematic reviews show that increasing tobacco tax has the most consistent positive equity impact of the tobacco control policies on SEP differences in smoking (Smith et al. 2020b; Hill et al. 2014; Thomas et al. 2008). The lower SEP groups are more sensitive to price increases, and therefore, increasing taxes is associated with decreasing smoking prevalence especially among the lower socioeconomic groups. The results of the current study are in agreement with these findings: adjusting for the real price index of cigarettes attenuated the estimate for the decreasing smoking trend among the less educated but had only modest impact on the estimates of the higher educated. The results also indicate that price increases affected the low socioeconomic groups, especially in the 2000s. Hu and colleagues (2017) observed that the affordability of cigarettes increased between 1990 and 2007 in Finland. Yet, during 2008 and 2016, there have been several tax increases amounting to an increase of 53% in the nominal prices of tobacco products (Virtanen and Rönkä 2017, p. 7, Appendix Table 15). Thus, the finding that the price influenced smoking prevalence more from 2009 onwards seems plausible. Different SEP measures could have varying associations with the price of cigarettes. If income was used as the SEP measure

instead of education, SEP differences in smoking may have been less clear, but the effect of price could have been more pronounced than observed currently (Hill et al. 2014).

Comprehensive tobacco control policies seem to decrease smoking (Feliu et al. 2019). In addition to tax/price increases and to some extent targeted cessation services, the impact of other policies for decreasing inequalities in smoking between socioeconomic groups remains inconclusive (Smith et al. 2020b; Thomson et al. 2018; Hill et al. 2014; Hu et al. 2017). For example, an umbrella review (review of reviews) has suggested that smoking restrictions and smoking bans in workplaces and enclosed public places would lead to widening health inequalities although the results are highly mixed (Thomson et al. 2018; for the Finnish context see Heloma et al. 2001). Also, a combination of tax increases and smoking bans have been associated with widening socioeconomic differences in smoking in the Netherlands, having less impact on the less affluent smokers (Verdonk-Kleinjan et al. 2011). Hu and colleagues (2017), partly utilising the same data as in sub-study I, found that the price and non-price policies implemented in Europe have reduced the inequalities between socioeconomic groups but not enough to reverse the overall trend of widening differences in smoking. There is some evidence of some policy actions, such as point-of-sale ban, reducing differences in smoking while others, such as pictorial health warnings may increase these differences (Kuipers et al. 2017; Swayampakala et al. 2018). Several studies investigating the association between tobacco control policies and smoking by SEP show little evidence for reduced inequalities (Sandoval et al. 2018; Hoebel et al. 2018; Chang et al. 2019; Helakorpi et al. 2008).

In the current investigation, a steeper decrease in smoking prevalence among the lower SEP groups coincides with an active phase in tobacco control policy in the 2000s (see Figure 12 below). This change could be attributable, in part, to the regular price increases from 2009 onwards (Table 7; Virtanen and Rönkä 2017), but the impact of other implemented policy measures remain inconclusive. Corresponding to earlier investigations, the results from the current study show that smoking has decreased among all the socioeconomic groups during the course of the TA. The results also imply that inequalities in smoking have increased during this period: tobacco control policies including consistent tax increases, especially in the 2010s, have been incapable of eliminating inequalities in smoking in Finland.

Adolescents

Adolescent SEP was found to associate inversely with smoking so that smoking was more common among the lower socioeconomic groups. The results corroborate earlier Finnish and European studies (Moor et al. 2019; Tseveenjav et al. 2015; Doku et al. 2010; Karvonen et al. 1999; Øverland et al. 2010; Hagquist 2007). In the current study, a decrease in smoking was observed among both higher and lower SEP groups. An earlier Finnish study, in a different time period and with a different target population, indicated that smoking among 16–18-year-old adolescents with lower SEP plateaued or increased whereas smoking among the higher SEP adolescents decreased (Doku et al. 2010). Doku et al. (2010) studied adolescents from 1977 to 2007 and the current study from 2008 to 2017. Based on these findings, smoking among the lower socioeconomic groups has started to decrease later than smoking among the higher socioeconomic groups.

In the current study, the stable low and the downwardly mobile groups were at a markedly greater risk for smoking. The odds for smoking in the fully adjusted model was about 4.5 to 5.5 times higher among the stable low and the downward social mobility groups compared with the stable high group. These results are in accordance with earlier studies from Finland, Germany and Sweden (Karvonen et al. 1999; Kuntz and Lampert 2013; Novak et al. 2012). Also, two Finnish longitudinal studies following offspring until adulthood have pointed out that downwardly mobile groups may smoke more often although the associations have lacked statistical significance (Paavola et al. 2004; Pulkki et al. 2003). Some of the different findings may be attributable to different outcome measures (Sweeting and West 2001). The lack of association could imply either that the effect of parental SEP on offspring's smoking may attenuate over time or that the effect of a person's own SEP on his/her smoking may have masked the impact of parental SEP over time. It is also possible that adolescent's individual SEP plays a more crucial role in SEP differences in tobacco use than parental SEP (Moor et al. 2019; Doku et al. 2019; Kuntz and Lampert 2013; Doku et al. 2010; Paavola et al. 2004). The results from the current study support this interpretation for both smoking and snus use: great variation in the tobacco use among adolescents from the same parental background but with different individual SEP was observed (stable high vs. downwardly mobile / stable low vs. upwardly mobile).

Upward mobility has been shown to be associated with a smaller likelihood of smoking but not as consistently as downward mobility has increased the likelihood of smoking (Doku et al. 2019; Karvonen et al. 1999; Kuntz and Lampert 2013; Novak et al. 2012). In the fully adjusted models in the current study, upward mobility decreased the likelihood of smoking compared with the stable high group, while downward mobility increased the likelihood of smoking. Gugushvili et al. (2020) propose that mobility in itself may affect smoking through psychosocial factors: social mobility means that a person moves to a different position than his/her familial background, which may raise feelings of unsettlement that affect smoking. Elevated risk for smoking among the downward mobility group would then be explained by a greater psychological burden. In contrast, moving up the social hierarchy may enhance, for example, the sense of control of a person or other mental factors that can result in a lower smoking probability. Interpreting this in relation to the results of the current study, the effects of upward mobility seem to protect against smoking more than the joint effect of high parental SEP and high individual SEP.

Another explanation for the differences between social mobility classes could be that adolescents with lower smoking rates share some underlying characteristics that their peers in lower socioeconomic groups do not share. Lower SEP adolescents are exposed to parental risk factors for smoking more than higher SEP adolescents; that is, the distribution of social determinants of smoking differ between adolescent SEP groups (Doku et al. 2019; Doku et al. 2010; Alves et al. 2017). Also, the impact of psychosocial, social and societal factors relating to adolescent smoking may not be dismissed (Nonnemaker and Farrelly 2011; Pierce et al. 2005; Kobus 2003). The effect of friends' smoking, an important factor in adolescent smoking (Andersson and Maralani 2015; Kobus 2003), could not been taken into account in this investigation. It might be that the associations between social mobility classes and smoking would have attenuated more if the effect of peer smoking had been considered. Friends' smoking also relates to different school cultures and peer relations which may exceed the impact of parental factors. School

cultures and social practices may differ between the non-academically oriented and academically-oriented adolescents resulting in different tobacco use patterns (Kobus 2003).

There is little evidence on the association between SEP and snus use among adolescents. Studies imply that socioeconomic differences in snus use are modest and less pronounced than in smoking (Tseveenjav et al. 2015; Grøtvedt et al. 2008). Snus use has been associated with both higher parental and higher individual SEP, although some studies have found only a slight difference in snus use by adolescents' own SEP (Mattila et al. 2012; Tseveeenjav et al. 2015; Øverland et al. 2010; Grøtvedt et al. 2019). The findings from the current study correspond partially with these results: high parental SEP was associated with increased probability of snus use among adolescents with low individual SEP (downward mobile) compared with their peers with a high individual SEP (stable high). Individual socioeconomic position was associated with snus use, lower SEP groups being in an elevated risk. This implies that the social patterning of snus use may be different than for smoking (Mattila et al. 2012). Moreover, the social patterning may not yet be fully determined due to the rather strong increase in snus use (from 4% to 13% during 2008–2017), as well as recent increases in girls' snus use (Jääskeläinen and Virtanen 2019).

Individual (age), parental (parental smoking, parental unemployment), and macro-level factors (snus price in Sweden, study year) affected on the association between SEP and snus use only modestly. This supports earlier findings that parental smoking may not be an important determinant of adolescent snus use (Tseveenjav et al. 2015). Earlier studies have not taken the price of snus into account, and the results from this study imply that a more direct measure of local snus price should be utilised. The snus price in Sweden and its changes may not reflect the actual price adolescents are paying for it in Finland accurately enough. It is known that the price of snus affects its demand (Jawad et al. 2018), but studies on the effect of this price elasticity on adolescent snus use in the Nordic countries are lacking. Furthermore, the overall increase in the availability of snus in the Finnish black market has unknown effects on the price of snus that the users are actually paying; it could be assumed that the price decreases when the availability increases. Overall, the observed increases in snus use among adolescents are in line with increased availability of snus. Other explanations in the observed increase in snus use might relate to product development such as high nicotine concentration, youth appeal (NIPH 2019, pp. 37–39; Kostygina and Ling 2016), lower risk perceptions than for smoking (Kinnunen et al. 2019), or social acceptability (Lund et al. 2014).

The impact of tobacco control policies on socioeconomic differences in smoking among youth is inconclusive (Pförtner et al. 2016; Kuipers et al. 2015; Brown et al. 2014a; Thomas et al. 2008). In the current study, the impact of price increases on the association between SEP and tobacco use was negligible, although the price of cigarettes increased over the entire study periof. One possible reason for this may be the small changes in the real price index variable during the study period (range [1.11, 1.48]) which may have not detected "real" differences in smoking by SEP groups. Another explanation could be that increased use of snus has modified the association between cigarette price and smoking if, for example, some smokers have substituted smoking with snus use. However, a similar association between cigarette price and smoking was observed among boys and girls, which does not support this view as snus use was almost non-existent among girls. Yet one

explanation could be that the price of cigarettes does not affect adolescent smoking, which is improbable considering the accumulated evidence (Brown et al. 2014a; Thomas et al. 2008; Ross and Chaloupka 2003).

Some other policy actions, such as display ban (Ford et al. 2020) or extension of the school tobacco use bans (Kang and Cho 2020) could have also decreased adolescent smoking. However, there is indication that implementation of school smoking bans in Finland could have been more effective among the general upper secondary education than among the vocational education institutions (Kinnunen et al. 2019, pp. 48–49). In the UK, an increase in the legal age for tobacco purchase and legislation regulating smoke-free public places reduced SEP differences in smoking initiation (Anyanwu et al. 2020). In Australia, smoking has decreased among all SEP groups during an active tobacco control period, yet the change has been more pronounced among the high SEP group (White et al. 2008). Similar findings have been proposed in the Netherlands (Kuipers et al. 2014). The findings in the current investigation point to the direction of increasing inequalities: although a decrease in smoking among all SEP groups was detected, relative differences were larger at the end of the study period. If this trend continues among the adolescents and the future adult cohorts, the Finnish population seems to continue to occupy the fifth stage of the tobacco epidemic model – where successive lower SEP cohorts take up smoking more than the higher SEP groups (Dixon and Banwell 2009). Also, widening differences in snus use were detected, as the increase plateaued among high SEP adolescents but continued among the low SEP adolescents. Some adolescents may have switched from smoking to snus use due to further restrictions on smoking or for some other reason but longitudinal data would be needed to examine this. Snus use does not seem to follow the cigarette epidemic model exactly: even though its increase among boys can be attributed to stage 2 in the cigarette epidemic model (and the subsequent onset of snus use among girls, see Jääskeläinen and Virtanen 2019), the less clear and reverse SEP differences in snus use imply a need for a specific epidemic model for snus use. As there are differences in the history of snus use and legal status of snus, a comprehensive model for snus use in the Nordic countries may be challenging to establish (for Norway, see Tjora et al. [2020]).

Association between socioeconomic position and smoking cessation (III)

The few general adult population studies conducted have proposed that smoking cessation is more probable among the higher SEP groups, yet the evidence is mixed (Vangeli et al. 2011; Holm et al. 2017; Yi et al. 2017). The findings from the study at hand showed that a higher education is a predictor for smoking cessation among men. Similar association was observed among women, but it failed to reach statistical significance. Prior studies have suggested that lower SEP groups are less likely to quit smoking due to a higher risk for relapse, less motivation and less social support for quitting smoking, and a higher drop-out from cessation treatment programmes (van Wijk et al. 2019; Hiscock et al. 2012a). They may also face structural barriers such as the poor approachability of or inability to pay for smoking cessation services (van Wijk et al. 2019).

There could be at least three explanations for the different associations between SEP and smoking cessation observed between men and women. The first could be that, compared with the high SEP groups, women with lower SEP may be more inclined to stop

smoking than men with lower SEP resulting in less pronounced differences between socioeconomic groups among women. However, earlier results from a qualitative study of employed lower SEP men and women do not support this interpretation (Katainen 2012). As Katainen (2012) proposes, smoking is deeply embedded in the daily routines for both lower SEP men and lower SEP women, and men may be more negative about their smoking than women. The pooled results do not support this view either, as smoking cessation was more likely among men than women (Figure 10; see also Smith et al. 2020a).

The second explanation relates to the cigarette epidemic model and its latest developments (Thun et al. 2012). Since smoking was never as prevalent among women as among men, the socioeconomic distribution of smokers may be different between genders which could be then projected in the association between SEP and smoking cessation. Figure 9 in section 6.3 offers some support for this: among men, the distribution of education between continued smokers versus the quitters differs mainly for the highest and the lowest educational categories (percentage point differences between the educational categories: lowest 7%, middle 1%, highest 7%, respectively). For women, the proportion of the least educated differs only slightly between the continued smokers and the quitters (percentage point difference of 2%). Holm et al. (2017), who found a weaker association between education and smoking cessation among women than among men, provide support for this interpretation. The third explanation could relate to type II error: due to a limited number of observations, the analyses may have lacked statistical power to detect real SEP differences in smoking cessation among women. The observed direction of the association between SEP and smoking cessation among the higher educated women were still in the same direction as in the pooled analyses (men and women together) and among men (see Table 10).

The association between education and smoking cessation were modestly affected by the different background factors in the logistic regression models. These results reflect those of Broms et al. (2004) who found educational differences diminishing only slightly when taking smoking behaviour factors and demographic factors into account. According to a further examination with the KHB-method, the selected background factors reduced the effect of education and smoking cessation about one third (high education) to slightly under 50% (middle education). Thus, the majority of this association remained unexplained. Some measures relating, for example, to structural barriers for smoking cessation or household-level factors (Chandola et al. 2004) could have explained the association more.

Different associations between SEP and smoking cessation may have been observed if a different measure for SEP had been used. Education was a stronger predictor of smoking cessation than occupational social class in an earlier Finnish study (Broms et al. 2004). An income measure was included in the models in the current investigation and it showed no association with smoking cessation. These observations imply that education is a stronger indicator for smoking cessation than the other two key measures for SEP.

Plasma cotinine level proved to be a persistent predictor for continued smoking. Other population-based studies have used predominantly a CPD-based measure of dependence, such as the Fagerström Test for Nicotine Dependence (Vangeli et al. 2011; Ranjit et al. 2020). The mutual adjustment for health-related factors revealed that the impact of CPD on the association between SEP and smoking was explained by other health-related factors, whereas the effect of cotinine remained stable. Thus, plasma cotinine is a stronger

predictor for smoking cessation when mutually adjusted with CPD. Still, sensitivity analyses showed parallel results when the variables where in the models by themselves (without the other measure of dependence), pointing out the usability of the subjective measure for investigating smoking cessation among the general adult population, as well. The finding that heavy alcohol use decreased the probability of smoking cessation may relate to the genetic factors that contribute to the co-use of tobacco and alcohol (Cross et al. 2017) but also to some social and societal factors. For example, life stressors, such as divorce or job loss may lead to both greater alcohol use and continued smoking (Henkel 2011). These factors are likely to play a role in the observed association between depression and smoking cessation as well (Fluharty et al. 2017). Taken together, men with lower SEP, stronger nicotine dependence, heavy alcohol use and more depression symptoms are at a higher risk for continued smoking, indicating the possibility of accumulated problems.

According to a systematic review, the national health care system in the UK has been able to reduce the differences in smoking cessation by recruiting relatively more low SEP smokers (Brown et al. 2014b). Another systematic review on European individual-level smoking cessation interventions found no intervention to be equity positive (to reduce smoking more among the lower SEP groups than among the higher SEP groups) (Brown et al. 2014c). The authors stated that untargeted smoking cessation interventions may have reduced adult smoking but are likely to have increased the differences in smoking between SEP groups (Brown et al. 2014c). The lack of studies limits the interpretation of the equity impact of the Finnish smoking cessation services.

As noted above, tax/price increases are the most consistent policy intervention with an equity positive impact (Smith et al. 2020b; Hill et al. 2014). Sub-study III data was gathered during 2000 and 2012 and cigarette affordability increased towards the end of this period (Hu et al. 2017). Tax increases since 2009 have increased the nominal price of cigarettes notably. Should there have been more tax increases before 2009, the differences in smoking cessation between SEP groups may have been more modest. There have been no consistent gender differences in the impact of tax/price increases (Amos et al. 2012), so the above discussed differences in smoking cessation by gender are unlikely to be due to the effect of tax increases. In the Netherlands, both the low SEP and the high SEP groups seem to have benefitted equally from the implemented tobacco control policies between 1988 and 2011 (Bosdriesz et al. 2015b). There is also some evidence of the introduction of a partial point-of-sale ban in England to have a temporary positive impact on attempts to quit smoking (Beard et al. 2019a). In Canada, provincial point-of-sale ban seemed to be associated with a lower likelihood of relapse while restrictions on menthol may support smoking cessation (Fleischer et al. 2019; Chaiton et al. 2020). However, the equity impact of these more recent policies is currently unknown.

Population acceptance of tobacco control (IV)

The results of the current study are in accordance with abundance of evidence from high-income countries showing high acceptance rates of tobacco control policies among the population. The results also corroborate with prior studies, whereby population groups differ in their acceptance of tobacco control policies especially by smoking status. Tobacco control measures are accepted to a higher degree among non-smokers than smokers, but smokers also accept the restrictions especially with regard to adolescent smoking.

Interpreting the results according to the flywheel model of tobacco control (Willemsen 2018), decreasing smoking rates and strong public support for tobacco control (backed up by international requirements by the EU and the WHO) have provided governments fruitful ground for adopting and implementing even stronger tobacco control policies. As smoking prevalence decreases and a larger proportion of the population are non-smokers, even stricter tobacco control measures could be implemented. This is consistent with the result that enactment of tobacco control policies was seen as insufficient; the population would like to see even stricter –or better implemented–tobacco control policy. This is in line with current studies from Norway and Denmark, and even a Finnish investigation from the mid-1970s (Sæbø and Lund 2019; Lund 2016; Lykke et al. 2016; Finnish Medical Journal 1975).

Willemsen (2018, pp. 92–97) suggests that cultural values and social norms play a crucial role in tobacco control. Hakkarainen (2013) has described the change in the cultural status of smoking in Finland between 1950 and 2012. He sees the state health administrators supported by a relatively small number of health advocates as the primary drivers for the change of the cultural status of tobacco, as opposed to pressure from wider social movements or organised citizens groups. Still, interpreting this against the flywheel concept, enacting and implementing tobacco control measures should have stagnated if the greater population should have not accepted the cultural change of tobacco and social norms regarding smoking. In contrast, the observations from the current investigation highlight the current situation of smoking being largely denormalised in the Finnish society.

The results showed that a minority of the population accept societal support for quitters. The acceptance rate of the measure was the highest among daily smokers, being only 59% (lowest acceptance rate was among never smokers, 39%). It might be that due to the denormalised position of smoking in society, the public health impact, as well as the practices of smoking cessation, is unfamiliar to the wider population, projecting the denormalised position of tobacco also in smoking cessation. Smoking may be seen as a personal responsibility (Rise et al. 2014), and its consequences, for example health care costs, are to be placed on smokers rather than on "innocent" groups. Even some smokers share this view. The rather negative views on smoking cessation may impede its practices and its positive public health outcomes at the societal level: smokers are not viewed as those needing or deserving help in quitting smoking, which may hinder some smokers from seeking treatment. Still, the majority of the Finnish smokers want to quit smoking (Jääskeläinen and Virtanen 2019, p. 5). The type of support was not explicitly stated in this measure for societal support for quitters (for example health care system, health care professionals, reimbursements for medicine expenses, etc.) which limits the interpretation.

In previous studies, the association between SEP and tobacco control opinions has been ambiguous (Thomson et al. 2016). In the current investigation, some associations between SEP and tobacco control opinions were observed. In the adjusted models, the low SEP groups were more supportive of workplace smoking bans compared with the high SEP groups. The workplace conditions may be different for these groups, for example in terms of SHS exposure (King et al. 2014). Lower SEP groups may be unintentionally exposed to SHS more at their workplaces compared with higher SEP groups which would explain why the lower SEP groups are more willing to restrict workplace smoking even more. In addition, the social environments at workplaces for different SEP groups may differ in

terms of smoking (Katainen 2012; Katainen 2010). These interpretations are supported by a borderline significant finding that the lower socioeconomic groups viewed enforcement of the TA as more insufficient than higher SEP groups (adjusted OR for the less educated 1.20, 95% CI 1.00–1.44; adjusted for age, gender, smoking status, education, marital status, exposure to SHS, income and alcohol use).

Interestingly enough, the lower SEP group seemed to be less supportive of societal support for quitters, although the difference did not reach statistical significance. This association was observed when taking the different smoking rates between SEP groups into account (adjusted OR 1.20, 95% CI 1.00–1.44). Since smoking is more common among the lower socioeconomic groups, opposite results would have been expected. One possible explanation for this finding could be that the reasoning for smoking and meanings of smoking may differ between SEP groups. These differences then also lead to different views on smoking cessation. Katainen (2010) found that the lower SEP groups are more hesitant to give positive meanings for their smoking while higher SEP groups were more willing to posit their smoking as controlled and pleasurable. Higher SEP groups experienced smoking also as a voluntary act, whereas lower SEP groups viewed smoking as more of a "bad habit" (Katainen 2010). People with this habit then may be viewed as not deserving to be treated with societal resources. The different results considering SEP and tobacco control opinions compared with earlier studies may result from the methodological differences: in the current study a more holistic methodology was utilised whereas earlier studies have generally examined acceptance of individual measures.

7.3 PUBLIC HEALTH RELEVANCE OF THE CURRENT STUDY

The present investigation has highlighted several aspects that are relevant for public health, tobacco control and future policymaking. Policy implications are further discussed in section 7.5.

Socioeconomic differences in smoking are a major cause for inequalities in health. The current study shows the long-term changes of the socioeconomic differences in smoking in a country with a strict tobacco control policy. The results revealed that while smoking has decreased, tobacco control policies have not been successful at removing differences in smoking between socioeconomic groups. Rather, inequalities in smoking have increased. Parallel findings were made considering adolescent smoking. In addition, adolescent snus use and socioeconomic differences in snus use have increased. This calls for more stringent policy and preventive actions to curb the negative development in snus use and the succeeding possible health inequalities.

The positive consequences of smoking cessation on the individual and public health are vast. Inequalities between SEP groups may arise if smoking cessation is more common among some groups than among other groups. The current study observed that among the general adult male population, higher SEP is associated with smoking cessation. A similar association was observed among women, but it was weaker. Higher levels of plasma cotinine were the strongest predictor of continued smoking among both men and women, indicating the role of high nicotine dependence as a hindrance to stopping smoking. In addition to high nicotine dependence, men confronting other health-related challenges

(heavy alcohol use, mental health problems) appear to need enhanced support for smoking cessation.

Lastly, opinions of the population play an integral role in the government's decision and willingness to adopt tobacco control measures. Opinions affect policymaking which in turn affects smoking rates. Smoking rates, then again, influence the denormalisation of smoking and tobacco control opinions. In the current study, the Finnish population was found to support even stronger tobacco control policy than implemented so far. The large acceptance of the policies, as well as the dissatisfaction with the enforcement of the policies, could be taken as a positive sign for compliance when enacting future policy measures. Some population groups generally disapprove policies more than others, namely smokers. There are some differences in the acceptance of tobacco control policies between SEP groups indicating that their social environments, for example working conditions, may differ. Societal support for smoking cessation is not widely supported which should be taken into account when communicating harms of smoking and nicotine dependence to the general population. It could be emphasised that nicotine dependence is a chronic disease rather than an individual's choice. This could yield more sympathy for the smokers and diminish the possible stigma related to smoking. It could also attribute the responsibility for the problem to more extrinsic factors (such as tobacco industry) rather than to the individual (Rise et al. 2014).

7.4 METHODOLOGICAL CONSIDERATIONS

This study utilised large population-based surveys and health studies to investigate different realms of the association between SEP and tobacco use. The study has investigated both adolescent and adult tobacco use as well as population attitudes towards smoking and tobacco control. The studies were nationally representative with fairly good response rates and highly comparable measures across points in time. Different studies were utilised to grasp a more comprehensive picture of SEP differences in tobacco use than could be done with fewer data sources. For the most part, the number of respondents was large enough to conduct stratified analyses (for example by gender). A major strength also relates to the measurements of smoking status used in the investigation: smoking status was based on two to five questions, making the classification more reliable than would have been with fewer measures. As suggested, both absolute and relative measures were utilised to examine SEP differences in tobacco use over time (Regidor 2004). An additional strength in the investigation is the rare possibility of utilising an objective measure of nicotine dependence in a longitudinal study design when examining smoking cessation among the general adult population. All in all, these strengths have enabled a comprehensive overview of the association between SEP and tobacco use and its changes in the Finnish society.

In addition to the aforementioned strengths, various limitations need to be discussed. The response rate varied between and within studies. Declining response rate is a common problem in population-based studies, leading to limitations on the external validity of the study. Earlier studies have found that non-responsiveness associates with both education and smoking, the less educated and smokers being those who are underrepresented in

surveys (Helakorpi et al. 2015; Reinikainen et al. 2017; Kopra et al. 2015; Grøtvedt et al. 2013). Sub-study I, especially, has probably overestimated the rate of the decline in smoking prevalence over time while underestimating the current smoking prevalence. The results of this sub-study should be viewed as conservative estimates – as underestimates rather than overestimates – of SEP differences in smoking. The observed SEP differences in smoking could have been more pronounced had the less educated and smokers responded more actively. However, some of the possible effects of non-responsiveness could be taken into account with post-stratification weights which were utilised to produce population-based estimates for adult smoking rates. Similarly, in sub-study IV, the attitudes towards tobacco control would have been more pronounced between smoking status groups had the smokers participated at a higher rate.

In sub-study I, both absolute (SII) and relative (RII) measures of inequality were used to give a more thorough picture of the changes in smoking by SEP (Regidor 2004). An absolute measure of education (such as the continuous number of school years) could have been used, but the analyses based on a continuous variable had convergence problems and did not iterate. Thus, the relative measure for education was used for consistency in all the analyses.

Since smoking is largely denormialised in society (Hakkarainen 2013), misreporting of smoking could have occurred. This study only included a self-reported smoking status (excluding the biochemically verified baseline information in sub-study III), which is still shown to be fairly accurate and does not vary by SEP (Vartiainen et al 2002, Hovanec et al. 2019). Since the number of observations in some of the analyses was limited, real associations may have gone unobserved which relates to the type II error. This may be one possible explanation of the non-significant associations between education as well as other background factors and smoking cessation among women (sub-study III).

Adjustments could be applied to take into account the possible differences between respondents on some of the main sociodemographic factors, such as age and gender. As noted above, in substudy I this was done by post-stratification. This was not possible in sub-study II due to the lack of national registers about the target population. As there is no exhaustive register about the institutions providing vocational education and training in Finland, the coverage rate for the vocational education institutions could not be estimated, which also poses a limitation in sub-study II. In general upper secondary schools, the coverage rate declined over time from 74% to 55%.

The effects of school non-response in school surveys have been found to be modest in estimated adolescent substance use prevalence (Thrul et al. 2016). The SEP measure in sub-study II relied on adolescent report of their parental education. Misreporting of parental SEP poses an additional source of bias to the results. However, adolescents' reports on parental education are shown to be more reliable with increasing age (Ridolfo and Maitland 2011). Moreover, it was not possible to take into account some of the factors that are known risk factors for adolescent smoking, such as peer smoking and family structure (Leonardi-Bee et al. 2011; Tyas and Pederson 1998). Instead, the high comparability of the included variables over time was preferred. It has been proposed that non-responsiveness does not associate with snus use among adolescents in Norway (Grøtvedt et al. 2013). Our estimates for snus use may not suffer from the challenges associated with non-responsiveness to the same degree as with smoking. However, snus has a different legal status in Norway and in Finland, which may affect the self-reporting

use of such a product. In sub-study II, intergenerational social mobility could be conceptualized as potential social mobility as the education of adolescents was still in progress. However, the educational track in the upper secondary level can be viewed as a rather good indicator of future educational level: in 2017, 85% of new university graduates had completed general upper secondary education, whereas 9% had completed vocational education (Vipunen, 2018).

The longitudinal data used in sub-study III had two time-points, which prohibits any causal associations to be examined. Also, the current data dates back almost a decade and the association between education and smoking cessation could have changed during this time. However, the results from sub-study I on smoking rates imply that SEP differences could be even more pronounced nowadays than with those presented in sub-study III.

As the different SEP measures are not interchangeable, the use of several measures of SEP has been proposed in health research (Laaksonen et al. 2005). Education was used as the sole measure of SEP in this investigation since it was available for all the substudies. Education is also the most commonly used measure in studies examining socioeconomic differences in smoking especially in Europe (Schaap and Kunst 2009). Thus, utilising education as the SEP measure also enabled a better comparison with prior investigations. Prior examinations have shown that occupation may have a less clear association with smoking than education (Laaksonen et al. 2005; Lahelma et al. 2016). Occupational structures also change over time which poses challenges for using occupation as a SEP measure (Lahelma 2010). Conducted sensitivity analyses showed a negligible or lack of effect of income on the association between education and tobacco control policy measures in the regression models (sub-study IV). In sub-study III, income was not associated with smoking cessation and it had, in addition to other demographic variables, only a modest effect on the association between education and smoking cessation. Measures of SEP are not interchangeable in the context of socioeconomic differences in smoking among the Finnish population but education appears to be the most useful single measure.

7.5 IMPLICATIONS FOR FUTURE STUDIES

Although this study has examined the association between SEP and tobacco use extensively, several accounts for future studies remain. Continuous monitoring of the SEP differences in tobacco use would be needed, as indicated by the increase in snus use among adolescents, for example. Also, a closer investigation of the smokers' nicotine dependence level by SEP and its change over time would yield additional information for public health practices. A more thorough examination of the actual impact of different policy actions on tobacco use, as well as tobacco use cessation by socioeconomic groups, would be essential. This would need, in addition to appropriate data, utilising time series or difference-in-difference analyses, for example (Beard et al. 2019b; Saeed et al. 2019). Taking into account novel tobacco and nicotine products for these investigations could be recommended. There is lack of studies on the population acceptance of new tobacco and nicotine products by SEP, which would yield for policymaking important information on the social norms considering these products. Similarly, investigating the population

acceptance of novel tobacco control policies would give supporting information for policymaking regarding future reforms of the TA.

Investigating SEP differences in adolescent tobacco use remains of great importance in terms of curbing the future inequalities in health. Tobacco and nicotine use trajectories by SEP should be carried out to gain currently limited knowledge about the possible switching between these products, dual or polyuse of these products, and cessation of use of these products. The influence of the price on the tobacco use among different SEP groups should be further examined. Although the price has been shown to be an important factor influencing adolescent tobacco use, this association was not observed in the current study. Also, taking into account school dynamics and norms between students (school class level), as well as geography and neighbourhood characteristics (school level), could provide additional information on the possible explanations of SEP differences in tobacco use (see Tolstrup et al. 2018).

Considering smoking cessation, general adult population data with more than two points of study would be of great value. The causal associations between SEP and smoking cessation in relation to background factors could then be studied more rigorously. These data should be adequately powered to address the examination by SEP. Including objective measurements of nicotine dependence both at the baseline and at the follow-up would enhance the internal validity of the investigation.

7.6 POLICY IMPLICATIONS: TRANSITION FROM OVERALL ACTIVE PERIOD TO ACTIVELY REDUCING DIFFERENCES IN TOBACCO USE

As the results showed, higher education is a protective factor in tobacco use. Raising the overall educational level among the population could lead to decreased tobacco use. However, as Mackenbach and Kunst (1997) indicate, the size of the group with lower SEP is largely outside the scope of influence of public health policy. Thus, implications related to modifiable factors are pivotal to consider. In the context of this investigation, tobacco control policy is highly relevant to acknowledge.

Considerable amount of evidence shows that increasing tobacco taxes or prices reduces both smoking and has a consistent pro-equity impact on the inequalities in smoking: they impact the lower SEP more than the higher SEP smokers (Boyle et al. 2019; Ekpu and Brown 2015; Smith et al. 2020b; Hill et al. 2014; Hiscock et al. 2012a; Main et al. 2008). The impact of other policy/intervention measures for reducing differences in smoking by SEP groups is inconclusive (Smith et al. 2020b; Thomson et al. 2018; Brown et al. 2014a; Brown et al. 2014c). For example, targeted cessation campaigns and services may reduce inequalities in health, while when untargeted they may increase health inequalities (Smith et al. 2020b; Brown et al 2014c). There is lack of coherent evidence on the policy actions that are effective in reducing SEP differences in smoking among adolescents (Pförtner et al. 2016; Brown et al. 2014a; Kuipers et al. 2015). Some studies show that stricter tobacco control policies tend to have a larger impact on the higher SEP adolescents than the lower SEP adolescents, but the evidence is inconclusive (Pförtner et al. 2016; Kuipers et al. 2015).

Tax increases decrease adolescent smoking rates but their effects on inequalities in smoking is undecided (Pförtner et al. 2016; Brown et al. 2014a).

Figure 12 illustrates adult daily smoking prevalence by educational group and national as well as international tobacco control policy actions from 1978 until 2016 in Finland (modified from sub-study I). It is evident that there has been a more active phase of enacting different tobacco control policies since the early 2000s compared with the preceding decades. During this active period of tobacco control, we see a continuing decrease in smoking rates among the low and the high SEP groups. Still, inequalities in smoking have not only persisted but increased during this time. The objective of the comprehensive health policy to reduce inequalities in health seems to be more unattainable than before. Although smoking has decreased since the enactment of the TA, differences in smoking between socioeconomic groups have widened. Thus, enacted policies have not been able to remove inequalities in smoking between socioeconomic groups. Considering the evidence from the current and prior research, future policies should concentrate heavily on the lower SEP groups to tackle inequalities in health. These should include, in addition to continuing tax increases, targeted cessation services.

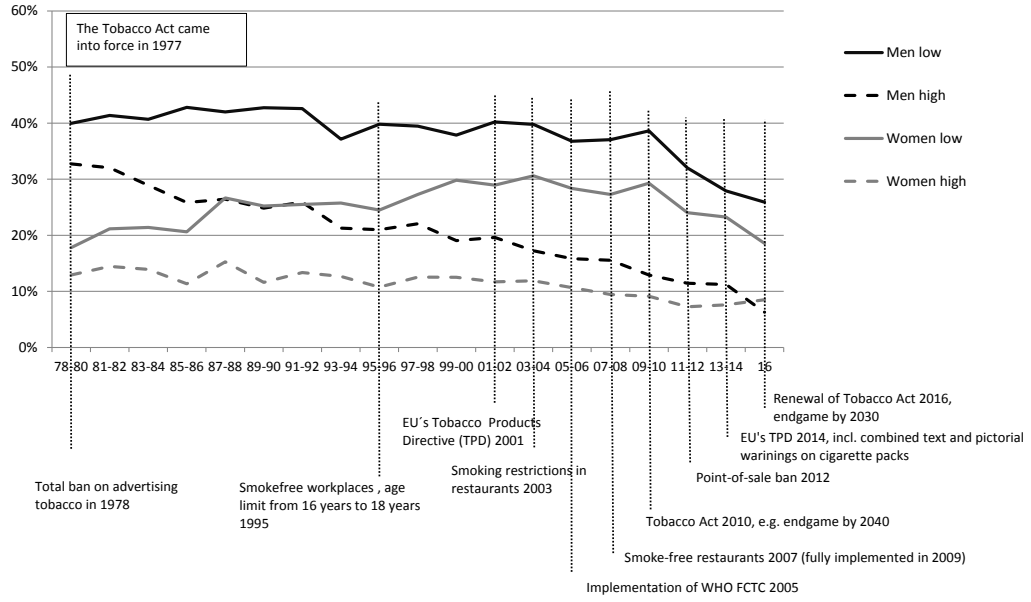

Figure 12 Daily smoking by gender and educational groups, %, 25–64-year-olds, age-adjusted, national and international tobacco control policy actions in 1978–2016 (modified from Figures 4 and 5).

Considering the public awareness of tobacco use and its SEP differences, one challenge in the objective of the TA is that it does not explicitly take into account different tobacco use rates among population subgroups. The objective is reached if the overall prevalence of tobacco and nicotine use among the population is no more than 5% by 2030. As this study shows, there are considerable and increasing differences in tobacco use rates by socioeconomic groups and these findings could be masked by reporting only the total

prevalence of the population. Thus, it would be important to consider these differences in reporting population tobacco use prevalence. According to the flywheel model of tobacco control (Willemsen 2018, see Figure 3 on section 2.4), this could influence future policymaking to take inequalities in tobacco use more carefully into consideration. Similarly, preventive work as well as overall health education should emphasise that nicotine dependence is a chronic disease and smokers should be positioned as deserving the necessary help to quit smoking. This could also impact the overall social norms concerning smoking and smoking cessation. It could also be communicated that smoking cessation is cost-effective (Ekpu and Brown 2015).

Raising tobacco taxes and prices decreases tobacco use and may reduce the inequalities in smoking among adolescents, also (Pförtner et al. 2016; Brown et al. 2014a). Thus, price increases could be continued to stall the negative development seen in inequalities in tobacco use. Adolescent smoking is strongly influenced by the average smoking rate of the population (Pförtner et al. 2016), so effective tobacco control actions to reduce adult smoking also influences adolescent smoking. Measures for limiting the availability of tobacco and nicotine products and preventing the uptake of tobacco include, for example, increasing the age-limit of buying tobacco. There is some evidence from Finland and the USA that raising the minimum age of buying cigarettes has a decreasing effect on the adolescent smoking rates (Rimpelä and Rainio 2004; Kessel Schneider et al. 2016; Institute of Medicine 2015). Also other limitations to the availability tobacco products should be considered. For example, a Finnish study has implied that increase in distance from home to the nearest tobacco outlet may promote smoking cessation (Pulakka et al. 2016). Reducing tobacco outlet density with special attention on reducing inequalities could be recommended (see Caryl et al. 2020). Since all the snus that adolescents are using in Finland is illegal (either based on age limit or ban on passing on or supply, see Finlex 2016b), different measures in addition to legislative measures must be considered to curb the use of snus among adolescents. These would include promoting snus use cessation and reducing the currently increased availability as well as social acceptability of snus.

Summing up, socioeconomic differences in tobacco use should be taken into account when enacting future policies and in communicating tobacco use prevalence in the population. Tax increases and targeted cessation services could be promoted for reducing inequalities in tobacco use. Further implementation of the WHO FCTC would decrease overall tobacco use. Furthermore, denormalising tobacco in society, for example by posing further restrictions on its use, could decrease adult smoking and therefore also affect adolescent smoking, change social norms and further policymaking. However, the social norms considering smoking cessation would need to be changed to more positive ones. Among adolescents, preventing initiation with further restrictions on the availability of tobacco could be recommended.

8 CONCLUSIONS

This study provided a comprehensive picture of socioeconomic differences in tobacco use in Finland, adopting population-based surveys and health research data. This investigation identified factors contributing to socioeconomic differences in tobacco use. The findings are highly relevant in support of reducing SEP differenes in smoking and promoting health equalities.

The results revealed that, although smoking has declined, large differences in smoking between SEP groups remain: the lower socioeconomic groups smoke more commonly than higher socioeconomic groups. These differences have increased over time. Socioeconomic differences in adolescent tobacco use have also increased. A higher socioeconomic position predicted a higher probability of smoking cessation, but no major differences were detected between SEP groups in the attitudes towards tobacco control.

The Finnish health policy has aimed to reduce inequalities in health of which the Tobacco Act with its objective of the endgame is a prime example. Although Finland has implemented and enacted relatively strict tobacco control policy for decades, it has not been able to eradicate the differences in smoking or smoking cessation between SEP groups. More intensive actions should be taken to reduce these inequalities. Such actions should be executed in several domains in society. Prevention of tobacco use among adolescents should continue and, in addition to smoking, also include snus use. Those on a non-academic school track, especially, should be identified and targeted early in their school years. Health care personnel should be further educated to use effective methods in helping smokers to quit. Cessation support should be targeted especially to the lower SEP groups and those with high nicotine dependence and other behavioural risk factors. Continuing tax and price increases would reduce inequalities in smoking by affecting the lower SEP smokers more. Further limitations on the availability of tobacco could also be initiated.

The Finnish population accepts strict tobacco control policies. More effective enforcement of the current policies as well as introducing novel policies could be recommended to curb the tobacco epidemic. Education about tobacco and nicotine dependence and its treatment could be recommended, to non-smokers also, so that attitudes towards societal support for smoking cessation would enjoy wider public acceptance.

Last, further studies are required to examine the impact of tobacco control policies on different aspects of tobacco use: initiation, maintenance and cessation. For example, prospective cohort studies with a sufficient number of observations, and modelling investigations on the effects of individual policy actions would be beneficial. A shared characteristic of future studies should be a careful examination of the difference between socioeconomic groups. Successfully implemented policy actions related to preventing and decreasing tobacco use are pivotal in promoting public health and reducing health inequalities in the future.

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REFERENCES

Agaku, I.T., Odani, S., Okuyemi, K.S., and Armour, B. Disparities in current cigarette smoking among US adults, 2002–2016. Tob Control 2020;29:269–276.

Agaku, I.T., Odani, S., Armour, B.S., and King, B.A. Adults' favorability toward prohibiting flavors in all tobacco products in the United States. Prev Med 2019;129:105862.

Alves, J., Perelman, J., Soto-Rojas, V., Richter, M., Rimpelä, A., Loureiro, I., Federico, B., Kuipers, M.A.G., Kunst, A.E., and Lorant, V. The role of parental smoking on adolescent smoking and its social patterning: a cross-sectional survey in six European cities. J Public Health 2017;39:339–346.

Alves, J., Kunst, A.E., and Perelman, J. Evolution of socioeconomic inequalities in smoking: results from the Portuguese national health interview surveys. BMC Public Health 2015;15:311.

Amos, A., Greaves, L., Nichter, M., and Bloch, M. Women and tobacco: a call for including gender in tobacco control research, policy and practice. Tob Control 2012;21:236–243.

Andersson, M.A., and Maralani, V. Early-life characteristics and educational disparities in smoking. Soc Sci Med 2015;144:138–147.

Anyanwu, P.E., Craig, P., Katikireddi, S.V., and Green, M.J. Impact of UK tobacco control policies on inequalities in youth smoking uptake: a natural experiment study. Published online 29 May . Nicotine Tob Res 2020.

Aromaa, A. Introduction. In Heistaro, S. (ed.) Methodology report: Health 2000 Survey. Publications of the National Public Health Institute B 26/2008. Helsinki: National Public Health Institute, 2008, p. 11.

Asthana, S., Labani, S., Kailash, U., Sinha, D.N., and Mehrotra, R. Association of smokeless tobacco use and oral cancer: a systematic global review and meta-analysis. Nicotine Tob Res 2019;21:1162–1171.

Bakhturidze, G.D., Mittelmark, M.B., Aarø, L.E., and Peikrishvili, N.T. Attitudes towards smoking restrictions and tobacco advertisement bans in Georgia. BMJ Open 2013;3:1.

Banks, E., Joshy, G., Weber, M.F., Liu, B., Grenfell, R., Egger, S., Paige, E., Lopez, A.D., Sitas, F., and Beral, V. Tobacco smoking and all-cause mortality in a large Australian cohort study: findings from a mature epidemic with current low smoking prevalence. BMC Medicine 2015;13:38.

Bauld, L., Ferguson, J., McEwen, A., and Hiscock, R. Evaluation of a drop-in rolling-group model of support to stop smoking. Addiction 2012;107:1687–1695.

Beard, E., Jackson, S.E., West, R., Kuipers, M.A.G., and Brown, J. Trends in attempts to quit smoking in England since 2007: a time series analysis of a range of population-level influences. Published online 16 August. Nicotine Tob Res 2019a.

Beard, E., Marsden, J., Brown, J., Tombor, I., Stapleton, J., Michie, S., and West, R. Understanding and using time series analyses in addiction research. Addiction 2019b;114:1866–1884.

Benowitz, N.L., Bernert, J.T., Foulds, J., Hecht, S.S., Jacob III, P., Jarvis, M.,J., Joseph, A., Oncken, C., and Piper, M.E. Biochemical verification of tobacco use and abstinence: 2019 update. Published online 1 October. Nicotine Tob Res 2019.

Bertollini, R., Ribeiro, S., Mauer-Stender, K., and Galea, G. Tobacco control in Europe: a policy review. Eur Respir Rev 2016;25:151-157.

Birge, M., Duffy, S., Miler, J.A., and Hajek, P. What proportion of people who try one cigarette become daily smokers? A meta-analysis of representative surveys. Nicotine Tob Res 2018;20:1427–1433.

Bolcic-Jankovic, D., and Biener, L. Public opinion about FDA regulation of menthol and nicotine. Tob Control 2015;24(e4):e241–e2454.

Bolin, K. Economic evaluation of smoking-cessation therapies. A critical and systematic review of simulation models. Pharmacoeconomics 2012;30:551–564.

Borodulin, K., Tolonen, H., Jousilahti, P., Jula, A., Juolevi, A., Koskinen, S., Kuulasmaa, K., Laatikainen, T., Männistö, S., Peltonen, M., Perola, M., Puska, P., Salomaa, V., Sundvall, J., Virtanen, S.M., and Vartiainen, E. Cohort profile: The National FINRISK Study. Int J Epidemiol 2018;47:696–696i.

Borodulin, K., Vartiainen, E., Peltonen, M., Jousilahti, P., Juolevi, A., Laatikainen, T., Männistö, S., Salomaa, V., Sundvall, J., and Puska, P. Forty-year trends in cardiovascular risk factors in Finland. Eur J Public Health 2015;25:539–546.

Bosdriesz, J.R., Willemsen, M.C., Stronks, K., and Kunst, A.E. Tobacco control policy and socio-economic inequalities in smoking in 27 European countries. Drug Alcohol Depend 2016;165:79–86.

Bosdriesz, J.R., Willemsen, M.C., Stronks, K., and Kunst, A.E. Socioeconomic inequalities in smoking cessation in 11 European countries from 1987 to 2012. J Epidemiol Community Health 2015a;69:886–892.

Bosdriesz, J.R., Nagelhout, G.E., Stronks, K., Willemsen, M.C., and Kunst, A.E. The association between tobacco control policy and educational inequalities in smoking cessation in the Netherlands from 1988 through 2011. Nicotine Tob Res 2015b;17:1369–1376.

Boyle, R.G., Stanton, C.A., Sharma, E., and Tang, Z. Examining quit attempts and successful quitting after recent cigarette tax increases. Prev Med 2019;118:226–231.

Braveman, P.A., Cubbin, C., Egerter, S., Chideay, S., Marchi, K.S., Metzler, M., and Posner, S. Socioeconomic status in health research: one size does not fit all. JAMA 2005;294:2879–2888.

Brennan, E., Ilchenko, E., Durkin, S.J., and Wakefield, M.A. Public support for introducing cigarette pack inserts in Australia. Published online 13 February. Tob Control 2020.

Broms, U., Silventoinen, K., Lahelma, E., Koskenvuo, M., and Kaprio, J. Smoking cessation by socioeconomic status and marital status: the contribution of smoking behavior and family background. Nicotine Tob Res 2004;6:447–455.

Brown, T., Platt, S., and Amos, A. Equity impact of interventions and policies to reduce smoking in youth: systematic review. Tob Control 2014a;23(e2):e98–e105.

Brown, T., Platt, S., and Amos, A. Equity impact of population-level interventions and policies to reduce smoking in adults: a systematic review. Drug Alcohol Depend 2014b;138:7–16.

Brown, T., Platt, S., and Amos, A. Equity impact of European individual-level smoking cessation interventions to reduce smoking in adults: a systematic review. Eur J Public Health 2014c;24:551–556.

Bruno, F., Costa, G., and Kunst, A.E. Educational inequalities in initiation, cessation, and prevalence of smoking among 3 Italian birth cohorts. Am J Public Health 2007;97:838–845.

Cantrell, J., Bennett, M., Mowery, P., Xiao, H., Rath, J., Hair, E., and Vallone, D. Patterns in first and daily cigarette initiation among youth and young adults from 2002 to 2015. PLoS One 2018;13: e0200827.

Caryl, F.M., Pearce, J., Reid, G., Mitchell, R., and Shortt, N.K. Simulating the density reduction and equity impact of potential tobacco retail control policies. Published online 4 November. Tob Control 2020.

Chaiton, M.O., Nicolau, I., Schwartz, R., Cohen, J.E., Soule, E., Zhang, B., and Eissenberg, T. Ban on menthol-flavoured tobacco products predicts cigarette cessation at 1 year: a population cohort study. Tob Control 2020;29:341–347.

Chandola, T., Head, J., and Bartley, M. Socio-demographic predictors of quitting smoking: how important are household factors? Addiction 2004;99:770–777.

Chang, Y., Kang, H-Y., Lim, D., Cho, H-J., and Khang, Y-H. Long-term trends in smoking prevalence and its socioeconomic inequalities in Korea, 1992–2016. Int J Equity Health 2019;18:148.

Chung-Hall, J., Craig, L., Gravely, S., Sansone, N., and Fong, G.T. Impact of the WHO FCTC over the first decade: a global evidence review prepared for the Impact Assessment Expert Group. Tob Control 2019;28(Suppl 2):s119–s128.

Clare, P., Slade, T., Courtney, R.J., Martire, K.A., and Mattick, R.P. Use of smoking cessation and quit support services by socioeconomic status over 10 years of the National Drug Strategy Household Survey. Nicotine Tob Res 2014;16:1647–1655.

Corsi, D.J., Boyle, M.H., Lear, S.A., Chow, C.K., Teo, K.K., and Subramanian, S.V. Trends in smoking in Canada from 1950 to 2011: progression of the tobacco epidemic according to socioeconomic status and geography. Cancer Causes Control 2014;25:45–57.

Cross, S.J., Lotfipour, S., and Leslie, F.M. Mechanisms and genetic factors underlying co-use of nicotine and alcohol or other drugs of abuse. Am J Drug Alcohol Abuse 2017;43:171–185.

Danielsson, M., Lammi, A., Siitonen, S., Ollgren, J., Pylkkänen, L., and Vasankari, T. Alarming development of dual snus and cigarette usage among young Finnish males. BMC Public Health 2019;19:1249.

Davey Smith, G., Ströbele, S.A., and Egger, M. Smoking and health promotion in Nazi Germany. J Epidemiol Community Health 1994;48:220–223.

De Looze, M., ter Bogt, T., Hublet, A., Kuntsche, E., Richter, M., Zsiros, E., Godeau, E., and Vollebergh, W. Trends in educational differences in adolescent daily smoking across Europe, 2002–10. Eur Journal Public Health 2013;23:846–852.

Degerlund Maldi, K., San Sebastian, M., Gustafsson, P.E., and Jonsson, F. Widespread and widely widening? Examining absolute socioeconomic health inequalities in northern Sweden across twelve health indicators. Int J Equity Health 2019;18:197.

Diepeveen, S., Ling, T., Suhrcke, M., Roland, M., and Marteau, T.M. Public acceptability of government intervention to change health-related behaviours: a systematic review and narrative synthesis. BMC Public Health 2013;13:1.

Díez-Izquierdo, A., Lidón-Moyano, C., Martín-Sánchez, J.C., Matilla-Santander, N., Cassanello-Peñarroya, P., Balaguer, A., and Martínez-Sánchez, J.M. Smoke-free homes and attitudes towards banning smoking in vehicles carrying children in Spain (2016). Environ Res 2017;158:590–597.

Ding, D., Do, A., Schmidt, H-M., and Bauman, A.E. A widening gap? Changes in multiple lifestyle risk behaviours by socioeconomic status in New South Wales, Australia, 2002–2012. PLoS One 2015;10:1–13.

Dixon, J., and Banwell, C. Theory driven research designs for explaining behavioural health risk transitions: the case of smoking. Soc Sci Med 2009;68:2206–2214.

Dobewall, H., Koivusilta, L., Karvonen, S., Lindfors, P., Kinnunen, J.M., Vainikainen, M-P., and Rimpelä, A. Late start of upper secondary education and health-compromising behaviours among Finnish adolescents—a follow-up study. Published online 9 October. Eur J Public Health 2019.

Doku, D., Koivusilta, L., Rainio, S., and Rimpelä, A. Socioeconomic differences in smoking among Finnish adolescents from 1977 to 2007. J Adolesc Health 2010;47:479–487.

Doku, D.T., Acacio-Claro, P.J., Koivusilta, L., and Rimpelä, A. Social determinants of adolescent smoking over three generations. First published 11 April. Scand J Public Health 2019.

Doll, R., and Hill, AB. The mortality of doctors in relation to their smoking habits. Br Med J 1954;1:1451–1455.

Doll, R., Peto, R., Boreham, J., and Sutherland, I. Mortality in relation to smoking: 50 years' observations on male British doctors. BMJ 2004;328:1519.

Doll, R. Tobacco: a medical history. J Urban Health 1999;76:289–313.

Duncan, M.S., Freiberg, M.S., Greevey Jr, R.A., Kundu, S., Vasan, R.S., and Tindle, H.A. Association of smoking cessation with subsequent risk of cardiovascular disease. JAMA 2019;322:642–650.

Duodecim. Current Care Guidelines: Smoking prevention and cessation [in Finnish]. Published 19 June 2018. https://www.kaypahoito.fi/hoi40020 (accessed 22 April 2020)

Durazzo, T.C., Mattsson, N., Weiner, M.W., and Alzheimer's Disease Neuroimaging Initiative. Smoking and increased Alzheimer's disease risk: a review of potential mechanisms. Alzheimers Dement 2014;10(3 Suppl):S122–S145.

Dutra, L.M., and Glantz, S.A. Thirty-day smoking in adolescence is a strong predictor of smoking in young adulthood. Prev Med 2018;109:17–21.

East, K.A., Hitchman, S.C., McNeill, A., Ferguson, S.G., Yong, H-H., Cummings, K.M., Fong, G.T., and Borland, R. Trends in social norms towards smoking between 2002 and 2015 among daily smokers: findings from the International Tobacco Control Four Country Survey (ITC 4C). Published online 18 September, Nicotine Tob Res 2019.

Ebbert. J.O., Pattern, C.A., and Schroeder, D.R. The Fagerström Test for Nicotine Dependence-Smokeless Tobacco (FTND-ST). Addict Behav 2006;31:1716-1721.

Ekpu, V.U., and Brown, A.K. The economic impact of smoking and of reducing smoking prevalence: review of evidence. Tob Use Insights 2015;8.

England, L.J., Aagaard, K., Bloch, M., Conway, K., Cosgrove, K., Grana, R., Gould, T.J., Hatsukami, D., Jensen, F., Kandel, D., Lanphear, B., Leslie, F. Pauly, J.R., Neiderhiser, J., Rubinstein, M., Slotkin, T.A., Spindel, E., Stroud, L., and Wakschlag, L. Developmental toxicity of nicotine: a transdisciplinary synthesis and implications for emerging tobacco products. Neurosci Biobehav Rev 2017;72:176–189.

Engström, K., Magnusson, C., and Galanti, M.R. Socio-demographic, lifestyle and health characteristics among snus users and dual tobacco users in Stockholm County, Sweden. BMC Public Health 2010;10:619.

Ericsson, M., Pedersen, N.L., Johansson, A.L.V., Fors, S., and Dahl Aslan, A.K. Life-course socioeconomic differences and social mobility in preventable and non-preventable mortality: a study of Swedish twins. Int J Epidemiol 2019;48:1701–1709.

Ernstsen, L., Strand, B.H., Nilsen, S.M., Espnes, G.A., and Krokstad, S. Trends in absolute and relative educational inequalities in four modifiable ischaemic heart disease risk factors: repeated crosssectional surveys from the Nord-Trøndelag Health Study (HUNT) 1984–2008. BMC Public Health 2012;12:266.

European Commission. Attitudes of Europeans towards tobacco and electronic cigarettes. Special Eurobarometer 458. Brussels: European Union, 2017.

European Commission. Attitudes of Europeans towards tobacco and electronic cigarettes. Special Eurobarometer 429. Brussels: European Union, 2015.

European Commission. Smoking and the environment: attitudes and actions. Special Eurobarometer 183. Brussels: European Union, 2003.

Fagersröm, K. Determinants of tobacco use and renaming the FTND to the Fagerstrom Test for Cigarette Dependence. Nicotine Tob Res 2012;14:75–78.

Farley, S.M., Coady, M.H., Mandel-Ricci, J., Needham Waddell, E., Chan, C., Kilgore, E.A., and Kansagra, S.M. Public opinions on tax and retail-based tobacco control strategies. Tob Control 2015;24(e1):e10–e13.

Feliu, A., Filippidis, F.T., Joossens, L., Fong, G.T., Vardavas, C.I., Baena, A., Castellano, Y., Martínez, C., and Fernández, E. Impact of tobacco control policies on smoking prevalence and quit ratios in 27 European Union countries from 2006 to 2014. Tob Control 2019;28:101–109.

Fernández, E., Schiaffino, A., Borrell, C., Benach, J., Ariza, C., Ramon, J.M., Twose, J., Nebot, M., and Kunst, A. Social class, education, and smoking cessation: long-term follow-up of patients treated at a smoking cessation unit. Nicotine Tob Res 2006;8:29–36.

Finlex 2016a. Government proposal 15/2016. Available at: https://www.finlex.fi/fi/esitykset/he/2016/20160015 (in Finnish) (accessed 5 June 2020)

Finlex 2016b. Tobacco Act 549/2016. Available at: https://www.finlex.fi/fi/laki/kaannokset/2016/en20160549.pdf (accessed 5 June 2020)

Finnish Medical Journal. Käsitykset tupakoinnin haitoista vakiintuneet ja tupakkapolitiikasta vahvistuneet [Perceptions of the harms of smoking have become established and tobacco policy opinions have been strengthened]. Suomen Lääkärilehti [Finnish Medical Journal] 1975;30:2802–2806.

Fleischer, N.L., Lozano, P., Wu, Y-H., Hardin, J.W., Meng, G., Liese, A.D., Fong, G.T., and Trasher, J.F. Disentangling the roles of point-of-sale ban, tobacco retailer density and proximity on cessation and relapse among a cohort of smokers: findings from ITC Canada Survey. Tob Control 2019;28:81–87.

Fluharty, M., Taylor, A.E., Grabski, M., and Munafò, M.R. The association of cigarette smoking with depression and anxiety: a systematic review. Nicotine Tob Res 2017;19:3–13.

Ford, A., MacKintosh, A.M., Moodie, C., Kuipers, M.A.G., Hastings, G.B., and Bauld, L. Impact of a ban on the open display of tobacco products in retail outlets on never smoking youth in the UK: findings from a repeat cross-sectional survey before, during and after implementation. Tob Control 2020;29:282–288.

Gagné, T., Ghenadenik, A.E., Shareck, M., and Frohlich, K.L. Expected or completed? Comparing two measures of education and their relationship with social inequalities in health among young adults. Soc Indic Res 2018;135:549–562.

Gall, S.L., Abbott-Chapman, J., Patton, G.C., Dwyer, T., and Venn, A. Intergenerational educational mobility is associated with cardiovascular disease risk behaviours in a cohort of young Australian adults: The Childhood Determinants of Adult Health (CDAH) Study. BMC Public Health 2010;10:55.

Galobardes, B., Lynch, J., and Davey Smith, G. Measuring socioeconomic position in health research. Br Med Bull 2007;81-82:21–37.

Galobardes, B., Shaw, M., Lawlor, D.A., Lynch, J.W., and Davey Smith, G. Indicators of socioeconomic position (part 1). J Epidemiol Community Health 2006a;60:7–12.

Galobardes, B., Shaw, M., Lawlor, D.A., Lynch, J.W., and Davey Smith, G. Indicators of socioeconomic position (part 2). J Epidemiol Community Health 2006b;60:95–101.

Giskes, K., Kunst, A.E., Benach, J., Borrell, C., Costa, G., Dahl, E., Dalstra, J.A.A., Federico, B., Helmert, U., Judge, K., Lahelma, E., Moussa, K., Ostergren, P.O., Platt, S., Prättälä, R., Rasmussen, N.K., and Mackenbach, J.P. Trends in smoking behaviour between 1985 and 2000 in nine European countries by education. J Epidemiol Community Health 2005;59:395–401.

Glendinning, A., Shucksmith, J., and Hendry, L. Social-class and adolescent smoking-behavior. Soc Sci Med 1994;38:1449–1460.

Glymour, M.M, Avendano, M., and Kawachi, I. Socioeconomic status and health. In Berkman, L.F., Kawachi, I., and Glymour, M.M (eds.) Social epidemiology (2 ed.). Oxford University Press, 2015. Online version: 10.1093/med/ 9780195377903.001.0001 (accessed 11 June 2020)

Gmel, G., Clair, C., Rougemont-Bücking, A., Grazioli, V.S., Daeppen, J-B., Mohler-Kuo, M., and Studer, J. Snus and snuff use in Switzerland among young men: are there beneficial effects on smoking? Nicotine Tob Res 2018;20:1301–1309.

Goldman, N. Social Inequalities in health. Ann N Y Acad Sci 2001;954:118–139.

Gorber, S.C., Schofield-Hurwitz, S., Hardt, J., Levasseur, G., and Tremblay, M. The accuracy of self-reported smoking: a systematic review of the relationship between self-reported and cotinine-assessed smoking status. Nicotine Tob Res 2009;11:12-24.

Gorini, G., Carreras, G., Cortini, B., Verdi, S., Petronio, M.G., Sestini, P., and Chellini, E. Socioeconomic disparities in quitting smoking and in steps on the smoking cessation

pathway among smokers in Italy: findings from the SIDRIAT cohort study. Addict Res Theory 2018;26:63–70.

Graham, H., and Der, G. Patterns and predictors of smoking cessation among British women. Health Promot Int 1999;14:231–239.

Green, M.J., Leyland, A.H., Sweeting, H., and Benzeval, M. Socioeconomic position and early adolescent smoking development: evidence from the British Youth Panel Survey (1994–2008). Tob Control 2016;25:203–210.

Grøtvedt, L., Forsén, L., Ariansen, I., Graff-Iversen, S., and Holmen, T., L. Impact of snus use in teenage boys on tobacco use in young adulthood; a cohort from the HUNT Study Norway. BMC Public Health 2019;19:1265.

Grøtvedt, L., Forsén, L., Stavem, K., and Graff-Iversen, S. Patterns of snus and cigarette use: a study of Norwegian men followed from age 16 to 19. Tob Control 2013;22:382–388.

Grøtvedt, L., Stigum, H., Hovengen, R., and Graff-Iversen, S. Social differences in smoking and snuff use among Norwegian adolescents: a population based survey. BMC Public Health 2008;8:322.

Gugushvili, A., McKee, M., Murphy, M., Azarova, A., Irdam, D., Doniec, K., and King, L. Intergenerational mobility in relative educational attainment and health-related behaviours. Soc Indic Res 2019;141:413–441.

Gugushvili, A., Zhao, Y., and Bukodi, E. Intergenerational educational mobility and smoking: a study of 20 European countries using diagonal reference models. Public Health 2020;181:94–101.

Hagquist, C.E. Health inequalities among adolescents - the impact of academic orientation and parents' education. Eur J Public Health 2007;17:21–26.

Hagquist, C. Socioeconomic differences in smoking behaviour among adolescents: the role of academic orientation. Childhood 2000;7:467–478.

Hakkarainen, P. Tobacco Road Finland - how did an accepted pleasure turn into an avoidable risk behaviour? Soc Sci Med 2013;98:253–259.

Hamari, A.K., Toljamo, T.I., Kinnula, V.L., and Nieminen, P.A. Dual use of cigarettes and Swedish snuff (snus) among young adults in Northern Finland. Eur J Public Health 2013;23:768–771.

Hanibuchi, T., Nakaya, T., and Honjo, K. Trends in socioeconomic inequalities in self-rated health, smoking, and physical activity of Japanese adults from 2000 to 2010. SSM Popul Health 2016;2:662–673.

Harper, S., and Lynch, J. Trends in socioeconomic inequalities in adult health behaviors among U.S. states, 1990–2004. Public Health Rep 2007;122:177–189.

Haukkala, A., Vartiainen, E., and de Vries, H.. Progression of oral snuff use among Finnish 13-16-year-old students and its relation to smoking behaviour. Addiction 2006;101:581–589.

Hayes, L., Wakefield, M.A., and Bain, E. Change in public support for the introduction of plain packaging and new, enlarged graphic health warnings in the Australian state of Victoria, 2011-2013. Tob Control 2017;26:627–628.

Hayes, L., Wakefield, M.A., and Scollo, M.M. Public opinion about ending the sale of tobacco in Australia. Tob Control 2014;23:183–184.

Heatherton, T.F., Kozlowski, L.T., Frecker, R.C., and Fagerström, K.O. The Fagerström Test for Nicotine Dependence: a revision of the Fagerström Tolerance Questionnaire. Br J Addict 1991;86:1119–1127.

Heatherton, T.F., Kozlowski, L.T., Frecker, R.C., Rickert, W., and Robinson, J. Measuring the heaviness of smoking: using self-reported time to the first cigarette of the day and number of cigarettes smoked per day. Br J Addict 1989;84:791–799.

Heistaro, S. (ed.) Methodology report: Health 2000 Survey. Publications of the National Public Health Institute B 26/2008. Helsinki: National Public Health Institute, 2008.

Hedman, L., Katsaounou, P.A., Filippidis, F.T., Ravara, S.B., Lindberg, A., Janson, C., Gratziou, C., Rohde, G., Kyriakos, C.N., Mons, U., Fernández, E., Trofor, A.C., Demjén, T., Przewoźniak, K., Tountas, Y., Fong, G.T., and Vardavas, C.I., on behalf of the EUREST-PLUS consortiuml. Receiving support to quit smoking and quit attempts among smokers with and without smoking related diseases: findings from the EUREST-PLUS ITC Europe Surveys. Tob Induc Dis 2018;16:A14.

Helakorpi, S., Mäkelä, P., Holstila, A., Uutela, A., and Vartiainen, E. Can the accuracy of health behaviour surveys be improved by non-response follow-ups? Eur J Public Health 2015;25:487–490.

Helakorpi, S., Martelin, T., Torppa, J., Vartiainen, E., Uutela, A., and Patja K. Impact of the 1976 Tobacco Control Act in Finland on the proportion of ever daily smokers by socioeconomic status. Prev Med 2008;46:340–345.

Helakorpi, S., Uutela, A., Prättälä, R., and Puska, P. Health behaviour and health among Finnish adult population, spring 2000. Publications of the National Public Health Institute B8/ 2000. Helsinki: National Public Health Institute, 2000.

Helldán, A. and Helakorpi, S. Health Behaviour and Health among the Finnish Adult Population, Spring 2014. Report 6/2015. Helsinki: National Institute for Health and Welfare, 2015.

Heloma, A., Jaakkola, M.S., Kähkönen, E., and Reijula, K. The short-term impact of national smoke-free workplace legislation on passive smoking and tobacco use 2001. Am J Public Health 2001;91:1416–1418.

Heloma, A., and Jaakkola, M.S. Four-year follow-up of smoke exposure, attitudes and smoking behaviour following enactment of Finland's national smoke-free work-place law. Addiction 2003;98:1111–1117.

Henkel, D. Unemployment and substance use: a review of the literature (1990-2010). Curr Drug Abuse Rev 2011;4:4–27.

Hiilamo, H. Tobacco industry strategy to undermine tobacco control in Finland. Tob Control 2003;12:414–423.

Hill, S., Amos, A., Clifford, D., and Platt, S. Impact of tobacco control interventions on socioeconomic inequalities in smoking: review of the evidence. Tob Control 2014;23:e89–e97.

Hiscock, R., Bauld, L., Amos, A., Fidler, J.A., and Munafò, M. Socioeconomic status and smoking: a review. Ann N Y Acad Sci 2012a;1248:107–123.

Hiscock, R., Bauld, L., Amos, A., and Platt, S. Smoking and socioeconomic status in England: the rise of the never smoker and the disadvantaged smoker. J Public Health 2012b;34:390–396.

Hoebel, J., Kuntz, B., Kroll, L.E., Finger, J.D., Zeiher, J., Lange, C., and Lampert, T. Trends in absolute and relative educational inequalities in adult smoking since the early 2000s: the case of Germany. Nicotine Tob Res 2018;20:295–302.

Holm, M., Schiöler, L., Andersson, E., Forsberg, B., Gislason, T., Janson, C., Jogi, R., Schlünssen, V., Svanes, C., and Torén, K. Predictors of smoking cessation: a longitudinal study in a large cohort of smokers. Respir Med 2017;132:164–169.

Holstein B.E., Andersen, A., Damsgaard, M.T., Due, P., Bast, L.S., and Rasmussen, M. Trends in socioeconomic differences in daily smoking among 15-year-old Danes 1991–2014. Scand J Public Health 2020;48:667–673.

Hovanec, J., Weiss, T., Koch, H., Pesch, B., Behrens, T., Kendzia, B., Arendt, M., Dragano, N., Moebus, S., Schmidt, B., Brüning, T., and Jöckel, K-H. Smoking and urinary cotinine by socioeconomic status in the Heinz Nixdorf Recall Study. J Epidemiol Community Health 2019;73:489–495.

Hu, Y., van Lenthe, F.J., Platt, S., Bosdriesz, J.R., Lahelma, E., Menvielle, G., Regidor, E., Santana, P., de Gelder, R., and Mackenbach, J.P. The impact of tobacco control policies on smoking among socioeconomic groups in nine European countries, 1990–2007. Nicotine Tob Res 2017;19:1441–1449.

Huisman, M., Kunst, A.E., and Mackenbach, J.P. Educational inequalities in smoking among men and women aged 16 years and older in 11 European countries.Tob Control 2005;14:106–113.

Huisman, M., van Lenthe, F.J., Giskes, K., Kamphuis, C.B.M., Brug, J., and Mackenbach, J.P. Explaining socio-economic inequalities in daily smoking: a social-ecological approach. Eur J Public Health 2012;22:238–243.

Hummel, K., Nagelhout, G.E., Fong, G.T., Vardavas, C.I., Papadakis, S., Herbeć, A., Mons, U., van den Putte, B., Borland, R., Fernández, E., de Vries, H., McNeill, A., Gravely, S., Przewoźniak, K., Kovacs, P., Trofor, A.C., and Willemsen, M.C., on behalf of the EUREST-PLUS consortium. Quitting activity and use of cessation assistance reported by smokers in eight European countries: findings from the EUREST-PLUS ITC Europe Surveys. Tob Induc Dis 2018;16:A6.

Huurre, T., Aro, H., and Rahkonen, O. Well-being and health behaviour by parental socioeconomic status: a follow-up study of adolescents aged 16 until age 32 years. Soc Psychiatry Psychiatr Epidemiol 2003;38:249–255.

Hyland, A., Hassan, L.M., Higbee, C., Boudreau, C., Fong, G.T., Borland, R., Cummings, K.M., Yan, M., Thompson, M.E., and Hastings, G. The impact of smokefree legislation in Scotland: results from the Scottish ITC Scotland/UK longitudinal surveys. Eur J Public Health 2009;19:198–205.

Hyland, A., Li, Q., Bauer, J.E., Giovino, G.A., Steger, C., and Cummings, K.M. Predictors of cessation in a cohort of current and former smokers followed over 13 years. Nicotine Tob Res 2004;6(Suppl_3):S363–S369.

Hymowitz, N., Cummings, K.M., Hyland, A., Lynn, W.R., Pechacek, T.F., and Hartwell, T.D. Predictors of smoking cessation in a cohort of adult smokers followed for five years. Tob Control 1997;6(suppl 2):S57.

Härkänen, T., Kuulasmaa, K., Sares-Jäske, L., Jousilahti, P., Peltonen, M., Borodulin, K., Knekt, P., and Koskinen, S. Estimating expected life-years and risk factor associations with mortality in Finland: cohort study. BMJ Open 2020;10:e033741.

Härkänen, T. and Virtala, E. Sampling design. In Lundqvist, A. and Mäki-Opas, T. (eds.) Health 2011 Survey - Methods. Report 8/2016. Helsinki: The National Institute for Health and Welfare, 2016, pp. 18–23.

Härkönen, J., Lindberg, M., Karlsson, L., Karlsson, H., and Scheinin, N.M. Education is the strongest socio-economic predictor of smoking in pregnancy. Addiction 2018;113:1117–1126.

Institute for Health Metrics and Evaluation (IHME). Profile for Finland. Seattle, WA: IHME, University of Washington, 2019a. https://healthdata.org/finland (accessed 4 June 2020)

Institute for Health Metrics and Evaluation (IHME). GBD Compare. Seattle, WA: IHME, University of Washington, 2019b. http://vizhub.healthdata.org/gbd-compare (accessed 4 June 2020)

Ikonen, R., and Helakorpi, S. Lasten ja nuorten hyvinvointi – Kouluterveyskysely 2019. [Wellbeing of children and adolescents –School Health Promotion Study 2019] Statistical report 33/2019. Helsinki: Finnish Institute for Health and Welfare, 2019.

Institute of Medicine (IOM). Public health implications of raising the minimum age of legal access to tobacco products. Washington, DC: The National Academies Press, 2015.

Janssen, F., Gewily, S.E., and Bardoutsos, A. Smoking epidemic in Europe in the 21st century. Published online August 7th. Tob Control 2020.

Jawad, M., Lee, J.T., Glantz, S., and Millett, C. Price elasticity of demand of non-cigarette tobacco products: a systematic review and meta-analysis. Tob Control 2018;27:689–695.

Jha, P., Ramasundarahettige, C., Landsman, V., Rostron, B., Thun, M., Anderson, R.N., McAfee, T., and Peto, R. 21st-century hazards of smoking and benefits of cessation in the United States. N Engl J Med 2013;368:341–350.

Jha, P., Peto, R., Zatonski, W., Boreham, J., Jarvis, M.J., and Lopez, A.D. Social inequalities in male mortality, and in male mortality from smoking: indirect estimation from national death rates in England and Wales, Poland, and North America. Lancet 2006;368:367–370.

Joossens, L., Feliu, A., and Fernandez, E. The Tobacco Control Scale 2019 in Europe. Brussels: Association of European Cancer Leagues, Catalan Institute of Oncology, 2020. https://www.tobaccocontrolscale.org/TCS2019.pdf (accessed 11 June 2020)

Jääskeläinen, M., and Virtanen, S. Tobacco statistics 2018. Statistical report 44/2019. Official Statistics of Finland. Helsinki: Finnish Institute for Health and Welfare, 2019.

Kang, H., and Cho, S. Cohort effects of tobacco control policy: evidence to support a tobacco-free norm through smoke-free policy. Tob Control 2020;29:96–102.

Karvonen, S., and Rahkonen, O. Subjective social status and health in young people. Sociol Health Illn 2011;33:372–383.

Karvonen, S., Rimpelä, A.H., and Rimpelä, M.K. Social mobility and health related behaviours in young people. J Epidemiol Community Health 1999;53:211–217.

Katainen, A. Smoking and workers' autonomy: a qualitative study on smoking practices in manual work. Health 2012;16:134–150.

Katainen, A. Social class differences in the accounts of smoking - striving for distinction. Sociol Health Illn 2010;32:1087–1101.

Kennedy, R.D., Behm, I., Craig, L., Thompson, M.E., Fong, G.T., Guignard, R., and Beck, F. Outdoor smoking behaviour and support for outdoor smoking restrictions before and after France's national smoking ban. Eur J Public Health 2012;22:29–34.

Kessel Schneider, S., Buka, S.L., Dash, K., Winickoff, J.P., and O'Donnell, L. Community reductions in youth smoking after raising the minimum tobacco sales age to 21. Tob Control 2016;25:355–359.

Kestilä, L., Koskinen, S., Martelin, T., Rahkonen, O., Pensola, T., Pirkola, S., Patja, K., and Aromaa, A. Influence of parental education, childhood adversities, and current living conditions on daily smoking in early adulthood. Eur J Public Health 2006;16:617–626.

King, B.A., Homa, D.M., Dube, S.R., and Babb, S.D. Exposure to secondhand smoke and attitudes toward smoke-free workplaces among employed U.S. adults: findings from the National Adult Tobacco Survey. Nicotine Tob Res 2014;16:1307–1318.

Kinnunen, J.M., Pere, L., Raisamo, S., Katainen, A., Myöhänen, A., Lahti, L., Ahtinen, S., Ollila, H., Lindfors, P., and Rimpelä, A. The Adolescent Health and Lifestyle Survey 2019: adolescent tobacco and alcohol use and gambling. Reports and Memorandums of the Ministry of Social Affairs and Health 2019:56. Helsinki: Ministry of Social Affairs and Health, 2019.

Knaappila, N., Marttunen, M., Fröjd, S., Lindberg, N., and Kaltiala-Heino, R. Socioeconomic trends in adolescent smoking in Finland from 2000 to 2015. J Adolesc Health 2018;64:776–782.

Kobus, K. Peers and adolescent smoking. Addiction 2003;98(Suppl 1):37–55.

Koivusilta, L., Rimpelä, A., and Rimpelä, M. Health related lifestyle in adolescence predicts adult educational level: a longitudinal study from Finland. J Epidemiol Community Health 1998;52:794–801.

Koivusilta, L.K., Rimpelä, A.H., and Kautiainen, S.M. Health inequality in adolescence. Does stratification occur by familial social background, family affluence, or personal social position? BMC Public Health 2006;6:110.

Koning, P., Webbink, D., and Martin, N.G. The effect of education on smoking behavior: new evidence from smoking durations of a sample of twins. Empir Econ 2015;48:1479–1497.

Kopra J., Härkänen, T., Tolonen, H., and Karvanen, J. Correcting for non-ignorable missingness in smoking trends. Stat 2015;4:1–14.

Kostygina, G., and Ling, P.M. Tobacco industry use of flavourings to promote smokeless tobacco products. Tob Control 2016;25:ii40–ii49.

Kowitt, S.D., Noar, S.M., Ranney, L.M., and Goldstein, A.O. Public attitudes toward larger cigarette pack warnings: results from a nationally representative U.S. sample. PloS One 2017;12:e0171496.

Krieger, N., Williams, D.R., and Moss, N.E. Measuring social class in US public health research: concepts, methodologies, and guidelines. Annu Rev Public Health 1997;18:341–378.

Kuijpers, T.G., Willemsen, M.C., and Kunst, A.E. Public support for tobacco control policies: the role of the protection of children against tobacco. Health Policy 2018;122:929–935.

Kuipers, M.A.G., Beard, E., Hitchman, S.C., Brown, J., Stronks, K., Kunst, A.E., McNeill, A., and West, R. Impact on smoking of England's 2012 partial tobacco point of sale display ban: a repeated cross-sectional national study. Tob Control 2017;26:141–148.

Kuipers, M.A.G., Monshouwer, K., Laar, M. van, and Kunst, A.E. Tobacco control and socioeconomic inequalities in adolescent smoking in Europe. Am J Prev Med 2015;49:e64–e72.

Kuipers, M.A.G., Nagelhout, G.E., Willemsen, M.C., and Kunst, A.E. Widening educational inequalities in adolescent smoking following national tobacco control policies in the Netherlands in 2003: a time-series analysis. Addiction 2014;109:1750–1759.

Kuntz, B., and Lampert, T. Educational differences in smoking among adolescents in Germany: what is the role of parental and adolescent education levels and intergenerational educational mobility? Int J Environ Res Public Health 2013;10:3015–3032.

Kvaavik, E., Lund, I., Nygard, M., and Hansen, B.T. Lifestyle correlates of female snus use and smoking: a large population-based survey of women in Norway. Nicotine Tob Res 2016;18:431–436.

Laaksonen, M., Rahkonen, O., Karvonen, S., and Lahelma, E. Socioeconomic status and smoking: analysing inequalities with multiple indicators. Eur J Public Health 2005;15:26–269.

Lahelma, E. Health and social stratification. In Cockerham W.C. (ed.) The New Blackwell Companion to Medical Sociology. Malden: John Wiley & Sons Ltd, 2010, pp. 71–96.

Lahelma, E., Martikainen, P., Laaksonen, M., and Aittomäki, A. Pathways between socioeconomic determinants of health. J Epidemiol Community Health 2004;58:327–332.

Lahelma, E., Pietiläinen, O., Ferrie, J., Kivimäki, M., Lahti, J., Marmot, M., Rahkonen, O., Sekine, M., Shipley, M., Tatsuse, T., and Lallukka, T. Changes over time in absolute and relative socioeconomic differences in smoking: a comparison of cohort studies from Britain, Finland, and Japan. Nicotine Tob Res 2016;18:1697–1704.

Laiho, J., Djerf, K., and Lehtonen, R. Sampling design. In Heistaro, S. (ed.) Methodology report: Health 2000 Survey. Publications of the National Public Health Institute B 26/2008. Helsinki: National Public Health Institute, 2008, pp. 13–15.

Lam, T.H. Absolute risk of tobacco deaths: one in two smokers will be killed by smoking: comment on "Smoking and all-cause mortality in older people." Arch Intern Med 2012;172:845–846.

Lauterstein, D., Hoshino, R., Gordon, T., Watkins, B-X., Weitzman, M., and Zelikoff, J. The changing face of tobacco use among United States youth. Curr Drug Abuse Rev 2014;7:29–43.

Lazuras, L., Rodafinos, A., Panagiotakos, D.B., Thyrian, J.R., John, U., and Polychronopoulos, E. Support for smoke-free policies in a pro-smoking culture: findings from the European survey on tobacco control attitudes and knowledge. Int J Public Health 2009;54:403–408.

Leite, A., Machado, A., Pinto, S., Nunes, B., and Matias Dias, C. Daily tobacco consumption and associated socioeconomic factors in the Portuguese population: National Health Interview Survey data 1987-2014. Revista Portuguesa de Cardiologia (English Edition) 2019;38:583–593.

Leon, M.E., Lugo, A., Boffetta, P., Gilmore, A., Ross, H., Schüz, J., La Vecchia, C., and Gallus, S. Smokeless tobacco use in Sweden and other 17 European countries. Eur J Public Health 2016;26:817–821.

Leonardi-Bee, J., Jere, M.L., and Britton, J. Exposure to parental and sibling smoking and the risk of smoking uptake in childhood and adolescence: a systematic review and meta-analysis. Thorax 2011;66:847–855.

Leppo, K., and Vertio, H. Smoking control in Finland: a case study in policy formulation and implementation. Health Promot Int 1986;1:5–17.

Levin, M.L., Goldstein, H., and Gerhardt, P.R. Cancer and tobacco smoking: a preliminary report. JAMA 1950;143:336–338.

Lewer, D., McKee, M., Gasparrini, A., Reeves, A., and de Oliveira, C. Socioeconomic position and mortality risk of smoking: evidence from the English Longitudinal Study of Ageing (ELSA). Eur J Public Health 2017;27:1068–1073.

Lidón-Moyano, C., Sampedro-Vida, M., Matilla-Santander, N., Martín-Sánchez, J.C., González-Marrón, A., Bunch, K., and Martínez-Sánchez, J.M. Attitudes towards tobacco product regulations and their relationship with the tobacco control policies. Prev Med 2018;111:67–72.

Lindström, M., Isacsson, S-O., and The Malmö Shoulder-Neck Study Group. Smoking cessation among daily smokers, aged 45–69 years: a longitudinal study in Malmö, Sweden. Addiction 2002;97:205–215.

Lopez, A.D., Collishaw, N.E., and Piha, T. A descriptive model of the cigarette epidemic in developed countries. Tob Control 1994;3:242–247.

Lund, M. Exploring smokers' opposition to proposed tobacco control strategies. Nordic Studies on Alcohol and Drugs 2016;33:321–334.

Lund, M., Lund, K.E., and Halkjelsvik, T. Contrasting smokers' and snus users' perceptions of their personal tobacco behavior in Norway. Nicotine Tob Res 2014;16:1577–1585.

Lundqvist, A., and Mäki-Opas, T. (eds.) Health 2011 Survey - Methods. Report 8/2016. Helsinki: The National Institute for Health and Welfare, 2016.

Lundqvist, A., Rissanen, H., Virtala, E., Härkänen, T., Peña, S., and Knekt, P. Participation. In Lundqvist, A. and Mäki-Opas, T. (eds.) Health 2011 Survey - Methods. Report 8/2016. Helsinki: The National Institute for Health and Welfare, 2016, pp. 46–53.

Lykke, M., Pisinger, C., and Glümer, C. Ready for a goodbye to tobacco? Assessment of support for endgame strategies on smoking among adults in a Danish regional health survey. Prev Med 2016;83:5–10.

Lykke, M., Helbech, B., and Glümer, C. Temporal changes in the attitude towards smoking bans in public arenas among adults in the Capital Region of Denmark from 2007 to 2010. Scand J Public Health 2014;42:401–408.

Lynch, J., and Kaplan, G. Socioeconomic position. In Berkman, L.F., and Kawachi, I. (eds) Social epidemiology. New York: Oxford University Press, 2000, pp. 13–35.

Mackenbach, J. Health inequalities: Europe in profile. Rotterdam: Erasmus MC University Medical Center, 2006. https://www.who.int/social_determinants/media/health_inequalities_europe.pdf (accessed 11 June 2020)

Mackenbach, J.P., Stirbu, I., Roskam, A-J.R., Schaap, M.M., Menvielle, G., Leinsalu, M., and Kunst, A.E. for the European Union Working Group on Socioeconomic Inequalities in Health. Socioeconomic inequalities in health in 22 European countries. N Engl J Med 2008;358:2468–2481.

Mackenbach, J.P., and Kunst, A.E. Measuring the magnitude of socio-economic inequalities in health: an overview of available measures illustrated with two examples from Europe. Soc Sci Med 1997;44:757–771.

MacKinnon, D.P., Krull, J.L., and Lockwood, C.M. Equivalence of the mediation, confounding and suppression effect. Prev Sci 2000;1:173.

Main, C., Thomas, S., Ogilvie, D., Stirk, L., Petticrew, M., Whitehead, M., and Sowden, A. Population tobacco control interventions and their effects on social inequalities in smoking: placing an equity lens on existing systematic reviews. BMC Public Health 2008;8:178.

Makate, M., Whetton, S., Tait, R.J., Tania, D., Scollo, M., Banks, E., Norman, R., Pidd, K., Roche, A.M., and Allsop, S. Tobacco cost of illness studies: a systematic review. Nicotine Tob Res 2020;22:458–465.

Malone, R.E., Grundy, Q., and Bero, L.A. Tobacco industry denormalisation as a tobacco control intervention: a review. Tob Control 2012;21:162–170.

Maralani, V. Educational inequalities in smoking: the role of initiation versus quitting. Soc Sci Med 2013;84:129–137.

Margolis, R. Educational differences in healthy behavior changes and adherence among middle-aged Americans. J Health Soc Behav 2013;54:353–368.

Marmot, M. Smoking and inequalities. Lancet 2006;368:341–342.

Martin, J.L., Barnes, I., Green, J., Reeves, G.K., Beral, V., and Floud, S. Social influences on smoking cessation in mid-life: prospective cohort of UK women. PLoS One 2019;14:e0226019.

Mattila, V.M., Raisamo, S., Pihlajamaki, H., Mäntysaari, M., and Rimpelä, A. Sports activity and the use of cigarettes and snus among young males in Finland in 1999–2010. BMC Public Health 2012;12:230.

Mayne, S.L., Gordon-Larsen, P., Schreiner, P.J., Widome, R., Jacobs, D.R., and Kershaw, K.N. Longitudinal associations of cigarette prices with smoking cessation: The Coronary Artery Risk Development in Young Adults Study. Nicotine Tob Res 2019;21:678–685.

McCartney, G., Bartley, M., Dundas, R, Katikireddi, S.,V., Mitchell, R., Popham, F., Walsh, D., and Wami, W. Theorising social class and its application to the study of health inequalities. SSM Popul Health 2019;7:100315.

McDaniel, P.A., Smith, E.A., and Malone, R.E. The tobacco endgame: a qualitative review and synthesis. Tob Control 2016;25:594–604.

McQueen, D.V. A research programme in lifestyle and health: methodological and theoretical considerations. Rev Epidemiol Sante Publique 1987;35:28–35.

Mejia, A.B., and Ling, P.M. Tobacco industry consumer research on smokeless tobacco users and product development. Am J Public Health 2010;100:78–87.

Melkas, T. Health in all policies as a priority in Finnish health policy: a case study on national health policy development. Scand J Public Health 2013;41(suppl11):3–28.

Metsämuuronen, J. Tutkimuksen tekemisen perusteet ihmistieteissä 4 - tutkijalaitos. Helsinki: International Methelp Oy, 2009.

Mons, U., Müezzinler, A., Gellert, C., Schöttker, B., Abnet, C.C., Bobak, M., de Groot, L., Freedman, N.D., Jansen, E., and Kee, F. on behalf of the CHANCES consortium. Impact of smoking and smoking cessation on cardiovascular events and mortality among older adults: meta-analysis of individual participant data from prospective cohort studies of the CHANCES consortium. BMJ 2015;350:h1551.

Mons, U., Nagelhout, G.E., Guignard, R., McNeill, A., van den Putte, B., Willemsen, M.C., Brenner, H., Pötschke-Langer, M., and Breitling, L.P. Comprehensive smoke-free policies attract more support from smokers in Europe than partial policies. Eur J Public Health 2012;22:10–16.

Moor, I., Kuipers, M.A.G., Lorant, V., Pförtner, T-K., Kinnunen, J.M., Rathmann, K., Perelman, J., Alves, J., Robert, P-O., Rimpelä, A., Kunst, A.E., and Richter, M. Inequalities in adolescent self-rated health and smoking in Europe: comparing different indicators of socioeconomic status. J Epidemiol Community Health 2019;73:963–970.

Moor, I., Rathmann, K., Lenzi, M., Pförtner, T-K., Nagelhout, G.E., de Looze, M., Bendtsen, P., Willemsen, M., Kannas, L., Kunst, A.E., and Richter, M. Socioeconomic

inequalities in adolescent smoking across 35 countries: a multilevel analysis of the role of family, school and peers. Eur J Public Health 2015;25:457–463.

Müezzinler, A., Mons, U., Gellert, C., Schöttker, B., Jansen, E., Kee, F., O´Doherty, M.G., Kuulasmaa, K., Freedman, N.D., Abnet, C.C., Wolk, A., Håkansson, N., Orsini, N., Wilsgaard, T., Bueno-de-Mesquita, B., van der Schouw, Y., Peeters, P.H.M, de Groot, L.C.P.G.M., Peters, A., Orfanos, P., Linneberg, A., Pisinger, C., Tamosiunas, A., Baceviciene, M., Luksiene, D., Bernotiene, G., Jousilahti, P., Kymmer-Petterson, U., Jansson, J.H., Söderberg, S., Eriksson, S., Jankovic, N., Sánchez, M-J., Veronesi, G., Sans, S., Drygas, W., Trichopoulou, A., Boffetta, P., and Brenner, H. Smoking and all-cause mortality in older adults: results from the CHANCES Consortium. Am J Prev Med 2015;49:e53–e63.

Murray, E.T., Mishra, G.D., Kuh, D., Guralnik, J., Black, S., and Hardy, R. Life course models of socioeconomic position and cardiovascular risk factors: 1946 birth cohort. Ann Epidemiol 2011;21:589–597.

National Cancer Institute (NCI) and Centers for Disease Control and Prevention (CDC). Smokeless tobacco and public health: a global perspective. NIH Publication No. 14-7983. Bethesda, MD: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention and National Institutes of Health, National Cancer Institute, 2014.

Nelson, D.E., Bland, S., Powell-Griner, E., Klein, R., Wells, H.E., Hogelin, G., and Marks, J.S. State trends in health risk factors and receipt of clinical preventive services among US adults during the 1990s. JAMA 2002;287:2659–2667.

Ng, M., Freeman, M.K., Fleming, T.D., Robinson, M., Dwyer-Lindgren, L., Thomson, B., Wollum, A., Sanman, E., Wulf, S., Lopez, A.D., Murray, C.J.L., and Gakidou, E. Smoking prevalence and cigarette consumption in 187 countries, 1980–2012. JAMA 2014;311:183–192.

Nieminen, P., Toljamo, T., Hamari, A., and Kinnula, V.L. Attitudes to new smoking restrictions and second-hand smoke among young Finnish males. Scand J Public Health 2010;38:817–825.

Norwegian Institute of Public Health (NIPH). Helserisiko ved snusbruk [Health risks from snus use]. Report 2019, version 2. Oslo: Norwegian Institute of Public Health, 2019. https://www.fhi.no/globalassets/bilder/rapporter-og-trykksaker/2019/helserisiko-ved-snusbruk-rapport-2019-v2.pdf (accessed 4 June 2020)

Nonnemaker, J.M., and Farrelly, M. Smoking initiation among youth: the role of cigarette excise taxes and prices by race/ethnicity and gender. J Health Econ 2011;30:560–567.

Novak, M., Ahlgren, C., and Hammarstrom, A. Social and health-related correlates of intergenerational and intragenerational social mobility among Swedish men and women. Public Health 2012;126:349–357.

Nyberg, S.T., Singh-Manoux, A., Pentti, J., Madsen, I.E.H., Sabia, S., Alfredsson, L., Bjorner, J.B., Borritz, M., Burr, M., Goldberg, M., Heikkilä, K., Jokela, M., Knutsson, A., Lallukka, T., Lindholm, J.V., Nielsen, M.L., Nordin, M., Oksanen, T., Pejtersen, J.H., Rahkonen, O., Rugulies, R., Shipley, M.J., Sipilä, P.N., Stenholm, S., Suominen, S., Vahtera, J., Virtanen, M., Westerlund, H., Zins, M., Hamer, M., Batty, G.D., and Kivimäki, M. Association of healthy lifestyle with years lived without major chronic diseases. Published online 6 April. JAMA Intern Med 2020.

Ordell, S., and Ekbäck, G. Smoking cessation and associated dental factors in a cohort of smokers born in 1942: 5 year follow up. Int Dent J 2019;69:107–112.

Øverland, S., Tjora, T., Hetland, J., and Leif, E.A. Associations between adolescent socioeducational status and use of snus and smoking. Tob Control 2010;19:291–296.

Paavola, M., Vartiainen, E., and Haukkala, A. Smoking from adolescence to adulthood: the effects of parental and own socioeconomic status. Eur J Public Health 2004;14:417–421.

Paavola, M., Vartiainen, E., and Puska, P. Predicting adult smoking: the influence of smoking during adolescence and smoking among friends and family. Health Educ Res 1996;11:309–315.

Paavola, M., Tikkanen, J., Heloma, A., and Koskela, K. Seurantatutkimus suomalaisten suhtautumisesta tupakointiin [A follow-up study of the attitudes towards smoking among the Finnish population]. Suomen Lääkärilehti [Finnish Medical Journal] 1991;46:721–724.

Pacheco, J. Attitudinal policy feedback and public opinion. Public Opin Q 2013;77:714–734.

Pacheco, J. Trends — public opinion on smoking and anti-Smoking policies. Public Opin Q 2011;75:576–592.

Pacheco, J. The Social Contagion Model: exploring the role of public opinion on the diffusion of antismoking legislation across the American states. J Polit 2012;74:182–202.

Patja, K. On the road to tobacco-free Finland. World Med J 2014;60:23–27.

Pedersen, W., and von Soest, T. How is low parental socioeconomic status associated with future smoking and nicotine dependence in offspring? A population-based longitudinal 13-year follow-up. Scand J Public Health 2017;45:16–24.

Pennanen, M., Haukkala, A., de Vries, H., and Vartiainen, E. Longitudinal study of relations between school achievement and smoking behavior among secondary school students in Finland: results of the ESFA study. Subst Use Misuse 2011;46:569–579.

Peto, R. Smoking and death: the past 40 years and the next 40. BMJ 1994;309:937–939.

Petrovic, D., de Mestral, C., Bochud, M., Bartley, M., Kivimäki, M., Vineis, P., Mackenbach, J., and Stringhini, S. The contribution of health behaviors to socioeconomic inequalities in health: a systematic review. Prev Med 2018;113:15–31.

Pförtner, T-K., Hublet, A., Schnohr, C.W., Rathmann, K., Moor, I., de Looze, M., Baška, T., Molcho, M., Kannas, L., Kunst, A.E., and Richter, M. Socioeconomic inequalities in the impact of tobacco control policies on adolescent smoking. A multilevel study in 29 European countries. Addict Behav 2016;53:58–66.

Pierce, J.P., Distefan, J.M., Kaplan, R.M., and Gilpin, E.A. The role of curiosity in smoking initiation. Addict Behav 2005;30:685–696.

Pranttila, A. Rintamamiesten muonitus Suomessa sotavuosina 1939–1945. Publications of the Department of Applied Chemistry and Microbiology. Helsinki: University of Helsinki, 2006.

Proctor, R.N. The global smoking epidemic: a history and status report. Clin Lung Cancer 2004;5:371–376.

Pulakka, A., Halonen, J.I., Kawachi, I., Pentti, J., Stenholm, S., Jokela, M., Kaate, I., Koskenvuo, M., Vahtera, J., and Kivimäki, M. Association between distance from home to tobacco outlet and smoking cessation and relapse. JAMA Intern Med 2016;176:1512–1519.

Pulkki, L., Kivimäki, M., Elovainio, M., Viikari, J., and Keltikangas-Järvinen, L. Contribution of socioeconomic status to the association between hostility and cardiovascular risk behaviors: a prospective cohort study. Am J Epidemiol 2003;158:736–742.

Pärna, K., Pürjer, M-L., Ringmets, I., and Tekkel, M. Educational differences in cigarette smoking among adult population in Estonia, 1990-2010: does the trend fit the model of tobacco epidemic? BMC Public Health 2014;14:709.

Quesnel-Valleé, A., and Jenkins, T. Social policies and health inequalities. In Cockerham W.C. (ed) The New Blackwell Companion to Medical Sociology. Malden: John Wiley & Sons Ltd, 2010, pp. 455–483.

Rafful, C., García-Rodríguez, O., Wang, S., Secades-Villa, R., Martínez-Ortega, J.M., and Blanco, C. Predictors of quit attempts and successful quit attempts in a nationally representative sample of smokers. Addict Behav 2013;38:1920–1923.

Rahkonen, O., Laaksonen, M., and Karvonen, S. The contribution of lone parenthood and economic difficulties to smoking. Soc Sci Med 2005;61:211–216.

Rahkonen, O., Berg, M-A.,and Puska, P. Relationship between educational status, gender and smoking in Finland, 1978–1992. Health Promot Int 1995;10:115–120.

Ranjit, A., Latvala, A., Kinnunen, T.H., Kaprio, J., and Korhonen, T. Depressive symptoms predict smoking cessation in a 20-year longitudinal study of adult twins. Addict Behav 2020;108:106427.

Raptou, E., Galanopoulos, K., Katrakilidis, C., and Mattas, K. Public support toward tobacco control: consumer responsiveness and policy planning. Am J Health Behav 2012;36:666–680.

Rathmann, K., Moor, I., Kunst, A.E., Dragano, N., Pförtner, T-K., Elgar, F.J., Hurrelmann, K., Kannas, L., Baška, T., and Richter, M. Is educational differentiation associated with smoking and smoking inequalities in adolescence? A multilevel analysis across 27 European and North American countries. Sociol Health Illn 2016;38:1005–1025.

Regidor, E. Measures of health inequalities: part 2. J Epidemiol Community Health 2004;58:900–903.

Reidpath, D.D., Davey, T.M., Kadirvelu, A., Soyiri, I.N., and Allotey, P. Does one cigarette make an adolescent smoker, and is it influenced by age and age of smoking initiation? Evidence of association from the U.S. Youth Risk Behavior Surveillance System (2011). Prev Med 2014;59:37–41.

Reinikainen, J., Tolonen, H., Borodulin, K., Härkänen, T., Jousilahti, P., Karvanen, J., Koskinen, S., Kuulasmaa, K., Männistö, S., Rissanen, H., and Vartiainen, E. Participation rates by educational levels have diverged during 25 years in Finnish health examination surveys. Eur J Public Health 2018;28:237–243.

Reitsma, M.B., Fullman, N., Ng, M., Abajobir, A., Abate, K.H., Abbafati, C., Abera, S.F., Abraham, B., Abyu, G.Y., and Adebiyi, A.O., for the GBD 2015 Tobacco Collaborators. Smoking prevalence and attributable disease burden in 195 countries and territories, 1990–2015: a systematic analysis from the Global Burden of Disease Study 2015. Lancet 2017;389:1885–1906.

Richter, M., Erhart, M., Vereecken, C.A., Zambon, A., Boyce, W., and Gabhainn, S.N. The role of behavioural factors in explaining socio-economic differences in adolescent health: a multilevel study in 33 countries. Soc Sci Med 2009;69:396–403.

Ridolfo, H., and Maitland, A. Factors that influence the accuracy of adolescent proxy reporting of parental characteristics: a research note. J Adolesc 2011;34:95–103.

Rimpelä, A.H., and Rainio, S.U. The effectiveness of tobacco sales ban to minors: the case of Finland. Tob Control 2004;13:167–174.

Rimpelä, M. Aikuisten tupakointitapojen muutosten seuranta – katsaus Suomen Gallup Oy:n toteuttamien kyselytutkimusten tuloksiin ja seurantajärjestelmän kehittämiseen [Monitoring the changes in smoking among adults]. Sosiaalilääketieteellinen Aikakauslehti [Journal of Social Medicine]1978;15:112–123.

Rimpelä, M. Noin 2/3 väestöstä kannattaa tupakan hinnankorotuksia [About two thirds of the Finnish population support increases in cigarette prices]. Sosiaalinen aikakauskirja 1976;6:41–46.

Rise, J., Aarø, L.E., Halkjelsvik, T., and Kovac, V.B. The distribution and role of causal beliefs, inferences of responsibility, and moral emotions on willingness to help addicts among Norwegian adults. Addict Res Theory 2014;22:117–125.

Robert, S., and House, J.S. SES differentials in health by age and alternative indicators of SES. J Aging Health 1996;8:359–388.

Ross, H., and Chaloupka, F.J. The effect of cigarette prices on youth smoking. Health Econ 2003;12:217–230.

Saeed, S., Moodie, E.E.M., Strumpf, E.C., and Klein, M.B. Evaluating the impact of health policies: using a difference-in-differences approach. Int J Public Health 2019;64:637–642.

Sandoval, J.L., Leão, T., Cullati, S., Theler, J-M., Joost, S., Humair, J-P., Gaspoz, J-M., and Guessous, I. Public smoking ban and socioeconomic inequalities in smoking prevalence and cessation: a cross-sectional population-based study in Geneva, Switzerland (1995-2014). Tob Control 2018;27:663–669.

Schaap, M.M., and Kunst, A.E. Monitoring of socio-economic inequalities in smoking: learning from the experiences of recent scientific studies. Public Health 2009;123:103–109.

Schmidt, A.M., Kowitt, S.D., Myers, A.E., and Goldstein, A.O. Attitudes towards potential new tobacco control regulations among U.S. adults. Int J Environ Res Public Health 2018;15:72.

Shkolnikov, V.M., Churilova, E., Jdanov, D.A., Shalnova, S.A., Nilssen, O., Kudryavtsev, A., Cook, S., Malyutina, S., McKee, M., and Leon, D.A.. Time trends in smoking in Russia in the light of recent tobacco control measures: synthesis of evidence from multiple sources. BMC Public Health 2020;20:378

Sihto, M., Palosuo, H., and Linnanmäki, E. Reducing socio-economic inequalities in Finland: problems and opportunities. In Palosuo, H., Koskinen, S., Lahelma, E., Kostiainen, E., Prättälä, R., Martelin, T., Ostamo, A., Keskimäki, I., Sihto, M., and Linnanmäki, E. (eds). Health inequalities in Finland. Trends in socioeconomic health differences 1980–2005. Publications of Ministry of Social Affairs and Health 2009:9. Helsinki: Ministry of Social Affairs and Health, 2009, pp. 195–215.

Sihto, M., and Keskimäki, I. Does a policy matter? Assessing the Finnish health policy in relation to its equity goals. Crit Public Health 2000;10:273–286.

Singhammer, J., and Mittelmark, M.B. Standard measures of inter-generational social mobility distort actual patterns of mobility and health behaviour: evidence for a better methodology. Crit Public Health 2010;20:223–232.

Smith, C.E., Hill, S.E., and Amos, A. Impact of specialist and primary care stop smoking support on socioeconomic inequalities in cessation in the UK: a systematic review and national equity analysis. Addiction 2020a;115:34–46.

Smith, C.E., Hill, S.E., and Amos, A. Impact of population tobacco control interventions on socioeconomic inequalities in smoking: a systematic review and appraisal of future research directions. Published online 29 September. Tob Control 2020b.

Smith, K. E., Hill, S., and Bambra, C. Health inequalities: critical perspectives. Oxford: Oxford University Press, 2016.

Smith, P., Frank, J., and Mustard, C. Trends in educational inequalities in smoking and physical activity in Canada: 1974–2005. J Epidemiol Community Health 2009;63:317–323.

Sohlberg, T. In favour of tobacco control? Former smokers' support for tobacco policies. Nordic Studies on Alcohol and Drugs 2019;36:496–510.

Soneji, S., Sargent, J.D., Tanski, S.E., and Primack, B.A. Associations between initial water pipe tobacco smoking and snus use and subsequent cigarette smoking: results from a longitudinal study of US adolescents and young adults. JAMA Pediatr 2015;169:129–136.

Statistics Finland. Population by socio-economic status, main activity, sex, age and year, 2010-2017. Statistics Finland's PX-Web databases, 2020. http://pxnet2.stat.fi/PXWeb/pxweb/fi/StatFin/StatFin__vrm__tyokay/statfin_tyokay_pxt_115v.px/ (accessed 4 June 2020)

Statistics Finland. Population aged 15 or over by level of education, municipality, gender and age 1970–2018. Statistics Finland's PX-Web databases, 2019. http://pxnet2.stat.fi/PXWeb/pxweb/fi/StatFin/StatFin__kou__vkour/?tablelist=true (accessed 11 June 2020)

Stead, L.F., Buitrago, D., Preciado, N., Sanchez, G., Hartmann-Boyce, J., and Lancaster, T. Physician advice for smoking cessation. Cochrane Database Syst Rev 2013;5. Art. No.: CD000165.

Stead, L.F., Koilpillai, P., Fanshawe, T.R., and Lancaster, T. Combined pharmacotherapy and behavioural interventions for smoking cessation. Cochrane Database Syst Rev 2016;3. Art. No.: CD008286.

Stringhini, S., Carmeli, C., Jokela, M., Avendaño, M., Muenning, P., Guida, F., Ricceri, F., d´Errico, A., and Barros, H. for the LIFEPATH consortium. Socioeconomic status and the 25 × 25 risk factors as determinants of premature mortality: a multicohort study and meta-analysis of 1.7 million men and women. Lancet 2017;389:1229–1237.

Swayampakala, K., Thrasher, J.F., Yong, H-H., Nagelhout, G.E., Li, L., Borland, R., Hammond, D., O'Connor, R.J., and Hardin, J.W. Over-time impacts of pictorial health warning labels and their differences across smoker subgroups: results from adult smokers in Canada and Australia. Nicotine Tob Res 2018;20:888–896.

Sweeting, H., and Hunt, K. Adolescent socioeconomic and school-based social status, smoking, and drinking. J Adolesc Health 2015;57:37–45.

Sweeting, H., and West, P. Social class and smoking at age 15: the effect of different definitions of smoking. Addiction 2001;96:1357–1359.

Swift, E., Borland, R., Cummings, K.M., Fong, G.T., McNeill, A., Hammond, D., Trasher, J.F., Partos, T.R., and Yong, H.H. Australian smokers' support for plain or standardised packs before and after implementation: findings from the ITC Four Country Survey. Tob Control 2015;24:616–621.

Sæbø, G., and Lund, P.B. Children's right to smoke-free air: public support in Norway for banning smoking in vehicles with children present. Health Policy 2019;123:492–498.

Sæbø, G., and Scheffels, J. Assessing notions of denormalization and renormalization of smoking in light of e-cigarette regulation. Int J Drug Policy 2017;49:58–64.

Taioli, E., and Wynder, E.L. Effect of the age at which smoking begins on frequency of smoking in adulthood. N Engl J Med 1991;325:968–969.

Tanner, T., Kämppi, A., Päkkilä, J., Järvelin, M-R., Patinen, P., Tjäderhane, L., and Anttonen, V. Association of smoking and snuffing with dental caries occurrence in a young male population in Finland: a cross-sectional study. Acta Odontol Scand 2014;72:1017–1024.

Finnish Institute for Health and Welfare (THL). Sotkanet.fi. Statistical information on welfare and health in Finland, 2020a. Daily smokers (%), 20–64 years (indicator 4405). https://sotkanet.fi/sotkanet/en/index (accessed 30 September 2020)

Finnish Institute for Health and Welfare (THL). Aikuisten terveys,- hyvinvointi- ja palvelututkimus (ATH) [Regional Health and Well-being Study], 2020b. https://thl.fi/fi/tutkimus-ja-kehittaminen/tutkimukset-ja-hankkeet/finsote-tutkimus/aiemmat-tutkimukset/aikuisten-terveys-hyvinvointi-ja-palvelututkimus-ath- (accessed 2 June 2020)

Finnish Institute for Health and Welfare (THL). School Health Promotion Study, 2020c. https://thl.fi/en/web/thlfi-en/research-and-expertwork/population-studies/school-health-promotion-study (accessed 2 June 2020)

Finnish Institute for Health and Welfare (THL). Questionnaires. National FinHealth Study, 2017. https://thl.fi/en/web/thlfi-en/research-and-expertwork/population-studies/national-finhealth-study/questionnaires (accessed 17 June 2020)

Thomas, S., Fayter, D., Misso, K., Ogilvie, D., Petticrew, M., Sowden, A., Whitehead, M., and Worthy, G. Population tobacco control interventions and their effects on social inequalities in smoking: systematic review. Tob Control 2008;17:230–237.

Thomson, K., Hillier-Brown, F., Todd, A., McNamara, C., Huijts, T., and Bambra, C. The effects of public health policies on health inequalities in high-income countries: an umbrella review. BMC Public Health 2018;18:869.

Thomson, G., Wilson, N., Collins, D., and Edwards, R. Attitudes to smoke-free outdoor regulations in the USA and Canada: a review of 89 surveys. Tob Control 2016;25:506–516.

Thomson, G., Wilson, N., and Edwards, R. At the frontier of tobacco control: a brief review of public attitudes toward smoke-free outdoor places. Nicotine Tob Res 2009;11:584–590.

Thomson, G., and Wilson, N. Public attitudes to laws for smoke-free private vehicles: a brief review. Tob Control 2009;18:256–261.

Thrul, J., Pabst, A., and Kraus, L. The impact of school nonresponse on substance use prevalence estimates - Germany as a case study. Int J Drug Policy 2016;27:164–172.

Thun, M., Peto, R., Boreham, J., and Lopez, A.D. Stages of the cigarette epidemic on entering its second century. Tob Control 2012;21:96–101.

Thyrian, J.R., Panagiotakos, D.B., Polychronopulos, E., Willemsen, M.C., Zatoński, W., and John, U. The exposure to environmental tobacco smoke and attitudes towards tobacco control measures - a comparison of 5 European countries. Cent Eur J Public Health 2010;18:87–92.

Tjora, T., Skogen, J.C., and Sivertsen, B. Increasing similarities between young adults' smoking and snus use in Norway: a study of the trends and stages of smoking and snus epidemic from 2010 to 2018. BMC Public Health 2020;20:1511.

Tolstrup, J.S., Pisinger, V.S., Egan, K.K., and Christensen, A.I. Trends in smoking and smokeless tobacco use among Danish adolescents, 1997–2014. Tob Prev Cessat 2018;4:10.

Tseveenjav, B., Pesonen, P., and Virtanen, J.I. Use of snus, its association with smoking and alcohol consumption, and related attitudes among adolescents: the Finnish National School Health Promotion Study. Tob Induc Dis 2015;13:34.

Tyas, S.L., and Pederson, L.L. Psychosocial factors related to adolescent smoking: a critical review of the literature. Tob Control 1998;7:409–420.

U.S. Department of Health and Human Services (USDHHS). Smoking cessation. A report of the Surgeon General. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2020.

U.S. Department of Health and Human Services (USDHHS). The health consequences of smoking — 50 years of progress. A report of the Surgeon General. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2014.

U.S. Department of Health and Human Services (USDHHS). Preventing tobacco use among youth and young adults. A report of the Surgeon General. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2012.

U.S. Department of Health and Human Services (USDHHS). How tobacco smoke causes disease. The biology and behavioral basis for smoking-attributable disease. A report of the Surgeon General. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2010.

Van Mourik, D-J.A., Candel, M.J.J.M., Nagelhout, G.E., Willemsen, M.C., Fong, G.T., Hummel, K., van den Putte, B., and de Vries, H.. Support for a point-of-sale cigarette display ban among smokers: findings from the International Tobacco Control (ITC) Netherlands survey. BMC Public Health 2018;18:740.

Van Wijk, E.C., Landais, L.L., and Harting, J. Understanding the multitude of barriers that prevent smokers in lower socioeconomic groups from accessing smoking cessation support: a literature review. Prev Med 2019;123:143–151.

Vangeli, E., Stapleton, J., Smit, E.S., Borland, R., and West, R. Predictors of attempts to stop smoking and their success in adult general population samples: a systematic review. Addiction 2011;106:2110–2121.

Vartiainen, E., Seppälä, T., Lillsunde, P., and Puska, P. Validation of self reported smoking by serum cotinine measurement in a community-based study. J Epidemiol Community Health 2002;56:167–170.

Vedøy, T.F. Tracing the cigarette epidemic: an age-period-cohort study of education, gender and smoking using a pseudo-panel approach. Soc Sci Med 2014;48:35–47.

Verdonk-Kleinjan, W.M.I., Candel, M.J.J.M., Knibbe, R.A., Willemsen, M.C., and de Vries, H. Effects of a workplace-smoking ban in combination with tax increases on smoking in the Dutch population. Nicotine Tob Res 2011;13:412–418.

Vipunen. Education Statistics Finland. Aiempi ja myöhempi koulutus [Prior and later degrees], 2018. https://vipunen.fi/fi-fi/yliopisto/Sivut/Aiempi-ja-my%C3%B6hempi-koulutus.aspx (accessed 27 October 2020)

Virtanen, S. and Rönkä, S. Tobacco statistics 2016. Statistical Report 41/2017. Official Statistics of Finland. Helsinki: National Institute for Health and Welfare, 2017.

Vähänen, M. Tupakoinnin yhteiskunnalliset kustannukset ja niiden arviointimenetelmät. [Social costs of smoking and their assessment methods]. Report 15/2015. Helsinki: National Institute for Health and Welfare, 2015.

Wang, H., Naghavi, M., Allen, C., Barber, R.M., Bhutta, Z.A., Carter, A., Casey, D.C., Charlson, F.J., Chen, A.Z., and Coates, M.M for the GBD 2015 Mortality and Causes of Death Collaborators. Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980–2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet 2016;388:1459–1544.

Weinberger, A.H., Pilver, C.E., Mazure, C.M., and McKee, S.A. Stability of smoking status in the US population: a longitudinal investigation. Addiction 2014;109:1541–1553.

Wensink, M., Alvarez, J-A., Rizzi, S., Janssen, F., and Lindahl-Jacobsen, R. Progression of the smoking epidemic in high-income regions and its effects on male-female survival differences: a cohort-by-age analysis of 17 countries. BMC Public Health 2020;20:39.

White, V.M., Hayman, J., and Hill, D.J. Can population-based tobacco-control policies change smoking behaviors of adolescents from all socio-economic groups? Findings from Australia: 1987-2005. Cancer Causes Control 2008;19:631–640.

World Health Organization (WHO). Tobacco control measures, 2020. https://www.who.int/tobacco/control/measures/en/ (accessed 30 September 2020)

World Health Organization (WHO). European tobacco use: trends report 2019. Copenhagen: World Health Organization Regional Office for Europe, 2019. http://www.euro.who.int/__data/assets/pdf_file/0009/402777/Tobacco-Trends-Report-ENG-WEB.pdf (accessed 4 June 2020)

World Health Organization (WHO). WHO Framework Convention on Tobacco Control (WHO FCTC), 2003. https://www.who.int/fctc/text_download/en/ (accessed 17 June 2020)

World Health Organization (WHO). Guidelines for controlling and monitoring the tobacco epidemic. World Health Organization, Geneva, 1998.

Willemsen, M.C. Tobacco control policy in the Netherlands. Between economy, public health, and ideology. London: Palgrave Macmillan, 2018. https://doi.org/10.1007/978-3-319-72368-6 (accessed 1 June 2020)

Willemsen, M.C., Kiselinova, M., Nagelhout, G.E., Joossens, L., and Knibbe, R.A. Concern about passive smoking and tobacco control policies in European countries: an ecological study. BMC Public Health 2012;12:876–881.

Wynder, E.L., and Graham, E.A. Tobacco smoking as a possible etiologic factor in bronchiogenic carcinoma: a study of six hundred and eighty-four proved cases. JAMA 1950;143:329–336.

Yi, Z., Mayorga, M.E., Lich, K.H., and Pearson, J.L. Changes in cigarette smoking initiation, cessation, and relapse among US adults: a comparison of two longitudinal samples. Tob Induc Dis 2017;15:17.

Zhuang, Y-L., Gamst, A.C., Cummins, S.E., Wolfson, T., and Zhu, S-H. Comparison of smoking cessation between education groups: findings from 2 US national surveys over 2 decades. Am J Public Health 2015;105:373–379.

APPENDIX 1 DETERMINATION OF SMOKING STATUS VARIABLES IN SUB-STUDIES I-IV

APPENDIX 1a Determination of the smoking status, sub-study I, Health Behaviour and Health among the Finnish Adult Population / Regional Health and Well-being Study.

Smoking status[a]	Have you ever smoked?[b]	Have you ever smoked at least 100 times (cigarettes, cigars, pipes)?[c]	Have you ever smoked daily at least one year/how many years?[d]	When was the last time you smoked?[e]
1	.	.	.	1
1	.	.	2	1
1	2	.	.	1
1	2	2	.	1
1	2	2	2	1
2	.	.	1	.
2	2	.	1	.
2	2	2	.	2
2	2	2	1	1
2	2	2	1	2
2	2	2	2	2
3	2	2	.	3
3	2	2	2	3
3	2	2	2	4
4	.	.	.	7
4	2	.	.	5
4	2	.	.	7
4	2	2	.	5
4	2	2	.	6
4	2	2	.	7
4	2	2	2	5
4	2	2	2	6
4	2	2	2	7
5	.	1	.	.
5	1	.	.	.
5	2	.	1	3
5	2	.	1	4
5	2	.	1	5
5	2	.	1	7
5	2	1	.	.
5	2	2	1	3
5	2	2	1	4
5	2	2	1	5
5	2	2	1	6
5	2	2	1	7
9	2	.	.	.
9	2	2	.	.
9	2	2	1	.
9	2	2	2	.

. = No data / Question skipped based on earlier answers.

[a]: Smoking status values: 1= Daily smoker, 2= Occasional smoker, 3= Quitters 1–12 months ago, 4= Quitters over 1 year ago, 5= Never smoker, 9= Incomplete data.

[b]: Values 1= No, 2= Yes.

[c]: Values 1= No, 2= Yes.

[d]: Values 1= No, 2= Yes.
[e]: Values 1= Today or yesterday, 2= 2 days–1 month ago', 3= '1 month–six months ago', 4= 'six months–one year ago', 5= 'one year–five years ago', 6= 'six years–ten years ago', 7= 'over ten years ago'.

APPENDIX 1b Determination of the smoking status, sub-study II, School Health Promotion Study.

Smoking status[a]	How many cigarettes, pipefuls and cigars have you smoked altogether?[b]	Which of the following alternatives best describes your current smoking habits?[c]
4	1	.
4	2	.
1	3	1
2	3	2
2	3	3
3	3	4
1	4	1
2	4	2
2	4	3
3	4	4

. = No data / Question skipped based on earlier answers.

[a]: Smoking status values: 1 = Daily smoker, 2 = Occasional smoker, 3 = Quitter, 4 = Never smoker.

[b]: Values: 1 = None, 2 = Just one, 3 = About 2-50, 4 = More than 50.
[c]: Values: 1: I smoke once a day or more often, 2 = I smoke once a week or more often, but not every day, 3 = I smoke less often than once a week, 4 = I have quit smoking (temporarily or permanently).

APPENDIX 1c Determination of the baseline (A) and the follow-up smoking status (B), sub-study III, Health 2000 Survey and Health 2011 Survey.

A. BASELINE

Smoking status[a]	Have you ever smoked during your life time?[b]	Have you smoked at least 100 times during your life time (cigarettes, cigars or pipe tobacco)?[c]	Do you smoke nowadays (cigarettes, cigars or pipe)?[d]
1	1	1	1
2	1	1	2
3	1	1	3
3	2	.	.
3	1	2	.

. = No data / Question skipped based on the response to earlier answers.

[a]: Baseline smoking status values: 1 = Daily smoker, 2 = Occasional smoker, 3 = Non-smoker.

[b]: Values: 1: Yes, 2 = No.

[c]: 1 = Yes, 2 = No.

[d]: Values: 1 = Daily, 2 = Occasionally, 3 = Not at all.

B. FOLLOW-UP

Smoking status[a]	Have you ever smoked during your life time?[b]	Do you smoke nowadays (cigarettes, cigars or pipe)?[c]
1	1	1
2	1	2
3	1	3
3	0	.

. = No data / Question skipped based on earlier answers.

[a]: Follow-up smoking status values: 1 = Daily smoker, 2 = Occasional smoker, 3 = Non-smoker.

[b]: Values: 0 = No, 1 = Yes.

[c]: Values: 1 = Daily, 2 = Occasionally, 3 = Not at all.

APPENDIX 1d Determination of the smoking status, sub-study IV, the National FINRISK Study.

Smoking status[a]	Have you ever smoked?[b]	Have you during your life smoked at least 100 times (cigarettes, cigars or pipefuls)?[c]	Have you ever smoked regularly (almost every day for at least a year)?[d]	Do you smoke now (cigarettes, cigars, pipefuls)?[e]	When was the last time you smoked?[f]
0	1	.	.	.	.
0	2	1	.	.	.
0	.	1	.	.	.
0	2	2	1	.	.
0	.	2	1		
0	2	.	1		
0	.	.	1		
0	2	.	1		
0	.	.	1		
9	2	2	1	1	1
3	2	2	1	2	1
3	2	2	1	2	2
3	2	2	1	2	3
3	2	2	1	2	4
9	2	2	1	3	2
2	2	2	1	3	3
1	2	2	1	3	4
9	2	2	1	3	.
2	2	2	1	.	3
9	2	2	1	.	.
4	2	2	2	1	1
4	2	2	2	1	2
9	2	2	2	1	4
4	2	2	2	1	.
3	2	2	2	2	1
3	2	2	2	2	2
3	2	2	2	2	3
3	2	2	2	2	4
9	2	2	2	3	2
2	2	2	2	3	3
1	2	2	2	3	4
9	2	2	2	3	.
4	2	2	.	1	1
3	2	2	.	2	1
3	2	2	.	2	3
1	2	2	.	3	4

. = No data / Question skipped based on earlier answers.

[a]: Smoking status values: 0 = Never smokers, 1 = Former smoker, 2 = Recent quitter, 3 = Occasional smoker, 4 = Current daily smoker, 9 = Other.

[b]: Values: 1 = No, 2 = Yes.

[c]: Values: 1 = No, 2 = Yes.

[d]: Values: 1 = I have never smoked regularly, 2 = I have smoked regularly for (insert number) years.

[e]: Values: 1 = Yes, daily, 2 = Yes, occasionally, 3 = Not at all.

[f]: Values 1 = Yesterday or today, 2 = 2 days–1 month ago, 3 = 1 month–6 months ago, 4 = At least 6 months ago–over 10 years ago.

The answer to these cells does not affect the determination of smoking status.

APPENDIX 2 TOBACCO CONTROL PROPOSITIONS USED IN SUB-STUDY IV

Question number 49 on the National FINRISK Study 2012 survey questionnaire

In recent years, more and more restrictions have been placed on smoking in Finland. The following contains propositions regarding smoking and its restrictions. *Please mark on each line the alternative that best reflects your views.*

	completely disagree	somewhat disagree	neither agree nor disagree	somewhat agree	completely agree
Smoking is accepted in society	□	□	□	□	□
Workplaces are successfully smoke-free in Finland	□	□	□	□	□
Smokers take non-smokers into account when smoking	□	□	□	□	□
It is difficult for minors to get tobacco products	□	□	□	□	□
Smoking restrictions are enforced sufficiently	□	□	□	□	□
Youth smoking must be restricted	□	□	□	□	□
Tobacco must be sold in fewer places	□	□	□	□	□
Health care personnel must be allowed to smoke during working hours	□	□	□	□	□
Teachers must be allowed to smoke during working hours	□	□	□	□	□
Smoking should not be allowed in any profession during working hours	□	□	□	□	□
I like smoking	□	□	□	□	□
I like the smell of tobacco	□	□	□	□	□
Smoking on balconies should be forbidden by law	□	□	□	□	□
All smoking is not harmful	□	□	□	□	□
A non-smoker may get sick as a result of inhaling tobacco smoke	□	□	□	□	□
The warning texts on cigarette packs are useful	□	□	□	□	□
Nicotine replacement therapy products are easy to get	□	□	□	□	□
Nicotine replacement products are too expensive	□	□	□	□	□
Society should support people who quit smoking after getting sick from smoking	□	□	□	□	□
Society should support everyone who quits smoking	□	□	□	□	□
Smoking is a conscious choice, it is useless to blame the tobacco industry	□	□	□	□	□
Smuggled tobacco is available around me	□	□	□	□	□
A person who quits smoking needs the support of health care professionals	□	□	□	□	□
The main obstacle to quitting is insufficient information about the hazards of smoking	□	□	□	□	□
The main obstacle to quitting is the unwillingness to quit	□	□	□	□	□

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